SPACE SHUTTLE ORBITER TRIMMED CENTER-OF-GRAVITY EXTENSION STUDY: VOLUME VIII - EFFECTS OF CONFIGURATION MODIFICATIONS ON THE AERODYNAMIC CHARACTERISTICS OF THE 140 A/B ORBITER AT A MACH NUMBER OF 5.97

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SPACE SHUTTLE ORBITER TRIMMED CENTER-OF-GRAVITY EXTENSION STUDY

VOL. VIII - EFFECTS OF CONFIGURATION MODIFICATIONS

ON THE AERODYNAMIC CHARACTERISTICS OF THE 140 A/B ORBITER AT A

MACH NUMBER OF 5.97

by

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SUMMARY

Aerodynamic tests were conducted in the 20-Inch Mach 6.0 Tunnel to determine the effects of wing planform fillet, canard, and fuselage forebody camber modifications on the aerodynamic characteristics of the 140A/B Space Shuttle Orbiter Configuration.

The significant effect of the wing fillet and the canard modifications was to reduce the static longitudinal stability. No significant lateral-directional aerodynamic effects were produced by the modifications investigated.

All the modifcations moved the trimmed center-of-gravity location forward relative to the baseline configuration. The largest forward movement was the increment attributed to the addition of the large canard which amounted to almost 3 percent of the length.

INTRODUCTION

Limitations of the longitudinal center-of-gravity range of the Space Shuttle Orbiters for trimmed flight during entry, approach, and landing impose undesirable constraints on the allowable mass distributions for Shuttle return payloads. Therefore, studies were undertaken at the Langley Research Center to develop simple modifications which would produce the changes in configuration aerodynamics required to extend the orbiter center-of-gravity envelope. Modifications which were studied included changes in fuselage nose shape and wing fillet planform and the addition of fixed canard surfaces. Systems design analyses were undertaken to determine the weight penalties (ref. 1), and aerodynamic heating tests and analyses provided information on the impact of the modifications on thermal protection system requirements (ref. 2). Wind-tunnel force and moment tests were conducted across the speed range (refs. 3-7) to assess the effectiveness of the modifications in extending the center-of-gravity envelope and the influence of the modifications on flight characteristics.

The purpose of this paper is to present the effects of fuselage forebody, wing planform fillet, and canard modifications on the aerodynamic characteristics of the 140A/B orbiter configuration at a Mach number of 6.0. The wind-tunnel investigation was made in the Langley 20-Inch Mach 6.0 Tunnel at a Mach number of 5.97 and a Reynolds number of about 6.02×10^6, based on the fuselage reference length. The angles of attack of the investigation varied from about 15° to 35° at 0° and -5° sideslip angles.

SYMBOLS

The aerodynamic data are presented about the body system of axes with only the lift-drag ratios presented about the stability axis. All the aerodynamic data contained herein were nondimensionalized using the baseline model values

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for wing reference area, span, and mean aerodynamic chord. The moment reference point is located at 65 percent of the fuselage reference length (i.e. 21.38 cm (8.42 in.) aft of the model nose)). Values are given in both SI and US Customary Units. When two symbols are listed for an aerodynamic coefficient, the second symbol applies to the computerized tabulation of coefficients in the appendix.

A   aspect ratio

b   wing span, 23.79 cm (9.37 in.)

$\bar{c}$ mean aerodynamic chord, 12.06 cm (4.75 in.)

C_A, CA   axial-force coefficient, $\dfrac{\text{Axial force}}{q_\infty S}$

C_D, CD   drag coefficient $\dfrac{\text{Drag force}}{q_\infty S}$

C_L, CL   lift coefficient, $\dfrac{\text{Lift force}}{q_\infty S}$

C_ℓ, CBL   rolling-moment coefficient, $\dfrac{\text{Rolling moment}}{q_\infty S b}$

$C_{\beta\ell}$ $\left(\dfrac{\Delta C_\ell}{\Delta \beta}\right)_{\beta = 0°, 5°}$, per degree

C_m, CLM   pitching-moment coefficient, $\dfrac{\text{Pitching moment}}{q_\infty S \bar{c}}$

C_{n_β} $\qquad \left(\dfrac{\Delta C_n}{\Delta \beta}\right)_{\beta=0^\circ,5^\circ}$, per degree

C_{Y_β} $\qquad \left(\dfrac{\Delta C_Y}{\Delta \beta}\right)_{\beta=0^\circ,5}$, per degree

L/D $\qquad$ lift-drag ratio, $\dfrac{C_L}{C_D}$

ℓ $\qquad$ fuselage reference length, 32.77 cm (12.90 in.)

M $\qquad$ Mach number

pt $\qquad$ stagnation pressure, Pa

q_∞ $\qquad$ free-stream dynamic pressure, Newtons per meter^2 (lb/ft^2)

R_ℓ $\qquad$ free-stream Reynolds number based on ℓ

S $\qquad$ wing reference area, 0.025 m^2 (0.269 ft^2)

T_t $\qquad$ stagnation temperature, $^\circ$R

x_o, y_o $\qquad$ model stations, cm (in)

α $\qquad$ angle of attack, deg

β $\qquad$ sideslip angle, deg

δ_{BF} $\qquad$ body-flap deflection angle (positive for trailing edge down), deg

δ_e $\qquad$ elevon deflection angle (positive for trailing edge down), deg

δ_{SB} $\qquad$ split-rudder flare angle (positive for trailing edges deflected outboard), deg

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Model Configuration Components:

B_1WVS_0EF	baseline 140 A/B orbiter configuration
B_1	baseline fuselage forebody
B_2	negative cambered fuselage forebody
C_3	small canard with flat-plate airfoil sections
C_4	large canard with flat-plate airfoil sections
C_5	large blended canard
E	baseline elevon
F	baseline body flap
S_0	baseline planform fillet
S_2	fillet modification having planform geometry similar to a strake
V	baseline vertical tail
W	baseline wing (outboard panel) having a leading-edge sweep of 45°

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APPARATUS AND TESTS

Model

Geometric details of the model used in the wind-tunnel investigation are shown in figure 1 and table 1, and photographs of the model are shown in figure 2. The baseline configuration (fig. 1(a)) was an 0.01-scale model of the Rockwell International 140A/B Space Shuttle Orbiter configuration described in reference 3. The model had a removable fuselage forebody and removable components in the wing planform fillet region which allowed geometry modifications. The modifications shown in figures 1(b) through 1(e) were used in the present investigation and consisted of a negative cambered fuselage forebody, B_2; a wing planform fillet modification S_2; and three canard configurations: C_3, C_4, and C_5. All configurations in the present investigation incorporated a split-rudder flare angle of 55°.

The negative cambered forebody, B_2, (fig. 1(b)) had the same longitudinal distribution of cross sections as the baseline forebody, B_1. However, the vertical arrangement of the cross sections produced a negative cambered effect (turned up nose) for fuselage forebody B_2.

The planform fillet modification, S_2 (fig. 1(c)), had the fillet leading edges arranged in a strake-like planform. The forward portion of the S_2 fillet was swept back 67.4°, whereas the aft portion exhibited a leading-edge sweep angle of 85°. The outboard intersection of the modified fillet with the main wing panel occurred at the same longitudinal and transverse stations as the baseline planform fillet S_0. The streamwise sections of the modified fillet were faired with the main wing panel and had leading-edge radii indentical to those of the baseline fillet.

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Canards C_3 and C_4 (fig. 1(d)) had flat-plate sections with rounded leading edges and sharp trailing edges. The leading-edge sweep angles for canards C_3 and C_4 were 55.0° and 54.7°, respectively. The planform trailing edge of canards C_3 and C_4 was formed by circular arc segments having radii of 5.245 and 6.217 cm, respectively.

Canard C_5 (fig. 1(e)) was "blended" with the lower surface of planform fillet S_0. C_5 had a leading-edge sweep angle of 58.15° and a lower surface dihedral angle of 9.6°.

WIND TUNNEL

The investigation was conducted in the Langley 20-Inch Mach 6 Tunnel which is of the blowdown type, exhausting into the atmosphere. Operational stagnational pressure range for the facility is from about 7 to 37 atmospheres at stagnation temperatures up to 1000° R. A more complete description of the tunnel may be found in reference 8. Average test conditions for the investigation were:

$M = 5.97$

$P_t = 2187k$ Pa

$T_t = 861°$ R

$R_\ell = 6.02 \times 10^6$

Aerodynamic forces and moments acting on the model were measured using a six-component strain-gage balance. The wind-tunnel tests were run at an average Mach number of 5.97 at angles of attack from about 15° to 35° at 0° and -5° sideslip angles.

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RESULTS AND DISCUSSION

The aerodynamic data of the present study are tabulated in the appendix. A Data Set/Run Number Collation Summary (Table II) is included to expedite location of the data for a particular configuration.

Longitudinal Aerodynamic Characteristics

The longitudinal aerodynamic characteristics for the baseline orbiter configuration, $B_1 WVS_0 EF$, are shown in figure 3 for an elevon deflection angle range from $-40°$ to $10°$ and at body-flap deflections of $-11.7°$ and $16.3°$. Effects of the various configuration modifications investigated are presented in figure 4 as follows:

Effect of modification	Figure
B_2	4(a)
S_2	4(b)
$B_2 S_2$	4(c)
C_3	4(d)
$B_2 C_3$	4(e)
C_4	4(f)
C_5	4(g)

Effect of Fuselage Forebody Camber - Replacing the baseline fuselage forebody, B_1, with a negatively cambered forebody, B_2 (fig. 4(a)), produced a small positive increment in pitching moment along with an increase in the slope of axial-force coefficient versus angle of attack. The longitudial trim increment produced by the negative forebody camber was noted for both of the two control deflection conditions tested.

Effect of Planform Fillet Reshaping - Replacing the S_O baseline planform
fillet with the S_2 fillet (fig. 4(b)) provided significant destabilizing
increments in pitching-moment coefficients which were accompanied by increases
in C_N and C_A (again a $C_{A\alpha}$ increase). The destabilizing pitching-moment
increments found for the combined S_2 fillet/B_2 forebody modification
(fig. 4(c)) were somewhat larger than the increments noted for the S_2 planform
fillet modification alone.

Effects of Canards - Addition of the three canards C_3, C_4, and C_5
(figs. 4(d)-4(g)) provided significant positive pitching-moment increments over
the test angle-of-attack range. Addition of the cambered forebody, B_2, in
combination with the C_3 canard modification produced an additional pitch
increment. The magnitudes of the canard-produced pitching-moment increments
were proportional to the planform areas of the canards. The canard additions
also produced positive increments in normal force and the variation of axial
force with increasing angle of attack. The incremental effects of the canards
were similar to those noted for the S_2 planform fillet modification.

Effects of Modifications on Forward c.g. Trim Capability - The effects of the
modifications to the 140 A/B orbiter configuration in terms of center of gravity
(c.g.) forward movement are summarized in table III. The trimmable longitudinal
c.g. locations shown were determined for a nominal angle of attack of 24.1°
which is representative of the entry flight attitude of the orbiter at Mach
6.0. In order to determine conservative forward c.g. limits with the controls
set at maximum nose-up-trim conditons (δ_e=-40°,δ_{BF}=-11.7°), a $\pm 4°$ increment
was applied to the nominal angle of attack and a ΔC_m margin of -0.015 was used.
Similar analyses of the aft c.g. trim limits were made for δ_e= 10° and
δ_{BF}= 16.3. Since δ_e= 10° is not the maximum positive deflection angle of the
elevons, no C_m margin was requried.

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Each modification to the 140 A/B configuration shifted the trimmed c.g. locations forward. The large canard modification, C_4, provided the largest c.g. shift (2.96 percent of body length). The effect of cambering the fuselage forebody was to increase the trimmable forward c.g. position by about 0.43 percent of body length. All the remaining modifications (S_2, C_3, and C_5) provided forward c.g. increments of between 2.23 and 2.36 percent of the body length.

Lateral-Directional Aerodynamic Characteristics

The lateral-directional aerodynamic characteristics for the baseline 140 A/B is shown in figure 5(a) with figures 5(b)-5(h) showing similar data for the modified configurations. No significant lateral directional effects were produced by any of the configuration modifications investigated in this study.

SUMMARY OF RESULTS

Tests were conducted in the Langley 20-Inch Mach 6.0 Tunnel to determine the effects of wing planform fillet, canard, and fuselage forebody camber modifications on the aerodynamic characteristics of the 140 A/B Space Shuttle Orbiter configuration. The results are summarized as follows:

1. The significant effect of the wing fillet modification, S_2, and the canards C_3, C_4, and C_5 was to destabilize pitching moments. These same modifications produced no significant effects on the lateral-directional aerodynamic characteristics.

2. The most forward center-of-gravity locations for the modified configurations were ahead of those for the baseline 140 A/B configuration. The largest forward c.g. movement was the increment attributed to the addition of the large canard, C_4, which was almost 3 percent of the body length.

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6. Phillips, W. Pelham; and Fournier, Roger H.: Space Shuttle Orbiter Trimmed Center-of-Gravity Extension Study. Vol. V - Effects of Configuration Modifications on the Aerodynamic Characteristics of the 140 A/B Orbiter at Mach Numbers of 2.5, 3.95 and 4.6. NASA TM X-72661, 1979.

7. Phillips, W. Pelham: Space Shuttle Orbiter Trimmed Center-of-Gravity Extension Study. Vol. VII - Effects of Configuration Modifications on the Subsonic Aerodynamic Characteristics of the 140 A/B Orbiter at High Reynolds Numbers. NASA TMX-72661, 1981.

8. Sterrett, James R.; and Emery, James C.: Extension of Boundary-Layer-Separation Criteria to a Mach Number of 6.5 by Utilizing Flat Plates With Forward Facing Steps. NASA TND-618, 1960.

TABLE I. - MODEL GEOMETRY

Theoretical wing:

Area, planform, m^2 (ft^2) 0.02499 (0.2690)

Area, elevon, m^2 (ft^2) . . . . 0.001951 (.0210)

Span, cm (in.) 23.792 (9.367)

Chord, centerline root, cm (in.) 17.507 (6.892)

Chord, tip, cm (in.) 3.501 (1.378)

Taper ratio 0.20

Aspect ratio 2.265

Leading-edge sweep angle, deg 45.0

Trailing-edge sweep angle, deg . . . . -10.0

Dihedral angle, deg 3.5

Incidence angle, deg (yo = 5.056 cm) 0.5

Twist angle, deg 3.0

Airfoil section, tip . . . . 0012-64 modified

x_o, wing leading edge, plane of symmetry 21.234 (8.360)

Wing planform fillet S_0 baseline:

Leading-edge sweep angle, deg 80.9

x_o, wing leading-edge (theoretical) intersection cm (in.). 25.984 (10.230)

Wing planform fillet S_2

Leading-edge sweep angle (forward portion), deg 67.4

Leading-edge sweep angle (aft portion), deg 85.0

x_o, intersection of forward and aft fillet leading edges,
cm (in.) 12.929 (5.090)

x_o, intersection of aft fillet and theoretical wing,
cm (in.) 25.984 (10.130)

TABLE I. - CONCLUDED

Canard C_3:

    Exposed area, m^2 (ft^2) 0.001241 (0.013363)

    Leading-edge sweep angle, deg 54.7

Canard C_4:

    Exposed area, m^2 (ft^2) 0.002544 (0.027388)

    Leading-edge sweep angle, deg 54.7

Blended canard C_5:

    Exposed area, m^2 (ft^2) 0.001972 (0.02122)

    Leading-edge sweep angle, deg 58.15

Vertical tail:

    Area (theoretical), m^2 (ft^2) 0.003839 (0.041325)

    Leading-edge sweep angle, deg 45.0

    Root chord (theoretical), cm (in.) 6.820 (2.685)

    Tip chord (theoretical), cm (in.) 2.755 (1.085)

    Span, cam (in.) 8.019 (3.157)

Fuselage:

    Maximum cross-sectional area, m^2 (ft^2) . . . .   0.003595 (.0387)

    Length, cm (in.) 32.774 (12.903)

    Maximum width, cm (in.) 6.797 (2.676)

TABLE III. - LONGITUDINAL TRIM

LIMITS FOR CONFIGURATIONS INVESTIGATED

Configuration	Most forward c.g., %ℓ $(\Delta Cm = -.015)$	Most aft c.g., %ℓ $(\Delta Cm = 0)$	Forward c.g. increment, %ℓ
Baseline (B_1WVSoEF)	63.86	68.55	-
B_2WVSoEF	63.43	68.20	0.43
B_1WVS$_2$EF	61.61	66.29	2.25
B_2WVS$_2$EF	61.23	65.53	2.63
B_1WVSoC$_3$EF	61.63	66.40	2.23
B_2WVSoC$_3$EF	61.49	65.96	2.37
B_1WVSoC$_4$EF	60.90	65.62	2.96
B_1WVSoC$_5$EF	61.50	66.14	2.36

$$\alpha_{nom} = 24.1° \pm 4°$$

$S_{ref} = 0.02499 \text{ m}^2 \ (0.2690 \text{ ft}^2)$

$\bar{c} = 12.060 \text{ cm} \ (4.748 \text{ in})$

$b = 23.792 \text{ cm} \ (9.367 \text{ in})$

$l_{ref} = 32.774 \text{ cm} \ (12.903 \text{ in})$

$x_o = 13.444 \text{ cm} \ (5.293 \text{ in})$

$90.9°$

$x_o = 5.969 \text{ cm} \ (2.350 \text{ in})$

$x_o = 21.234 \text{ cm} \ (8.360 \text{ in})$

$x_o = 27.348 \text{ cm} \ (10.767 \text{ in})$

$3.175 \text{ cm} \ (1.250 \text{ in})$

$0.635 \text{ cm} \ (0.250 \text{ in})$
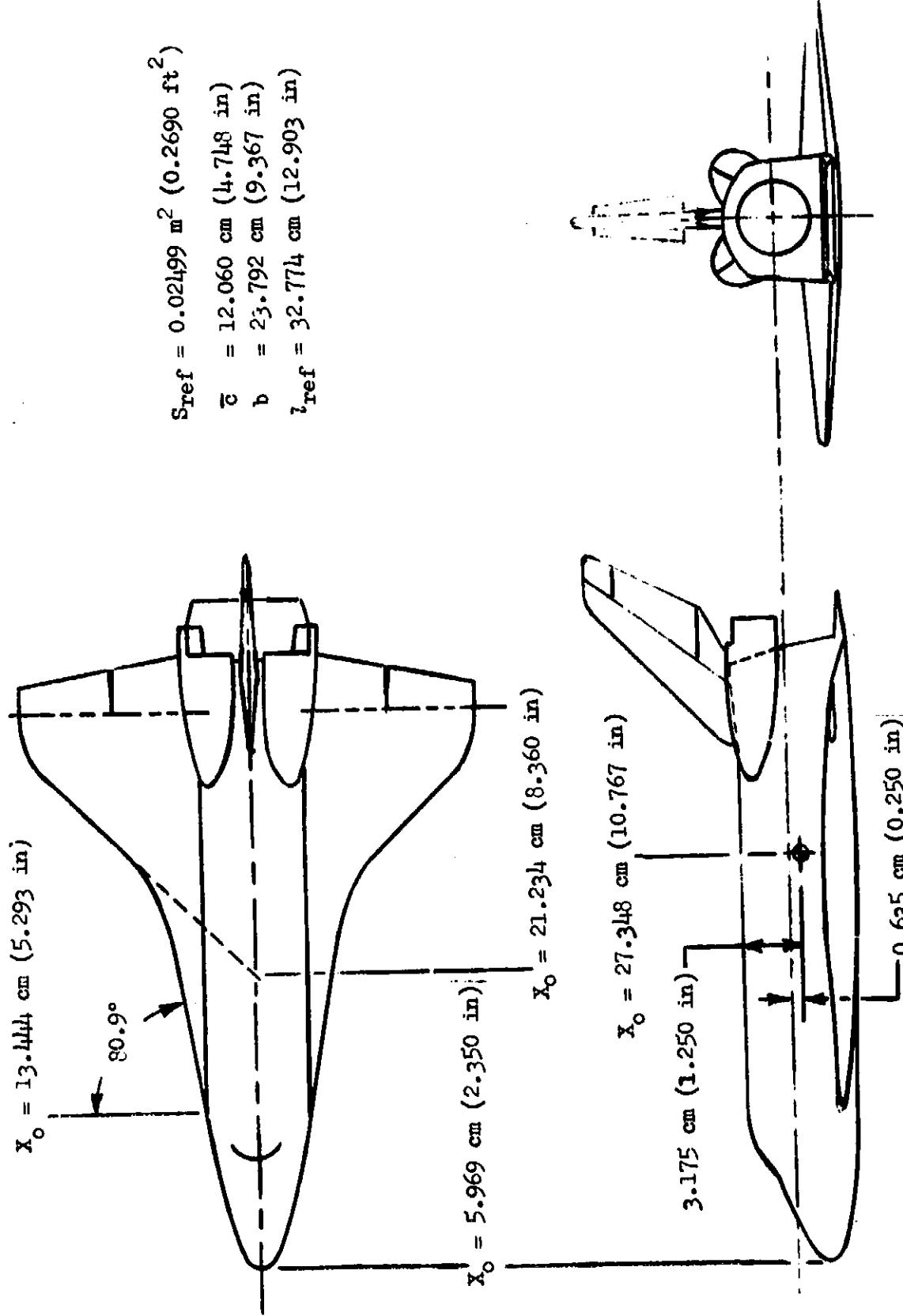
(a) Three-view of baseline orbiter model (Configuration B_1WVS_0EF)

Figure 1. - Model drawings.

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Station:

1.270 cm
(typical)

0.381 cm

0.508 cm

1.575 cm

$X_O = 5.969$ cm
(2.350 in)

Baseline forebody, B_1
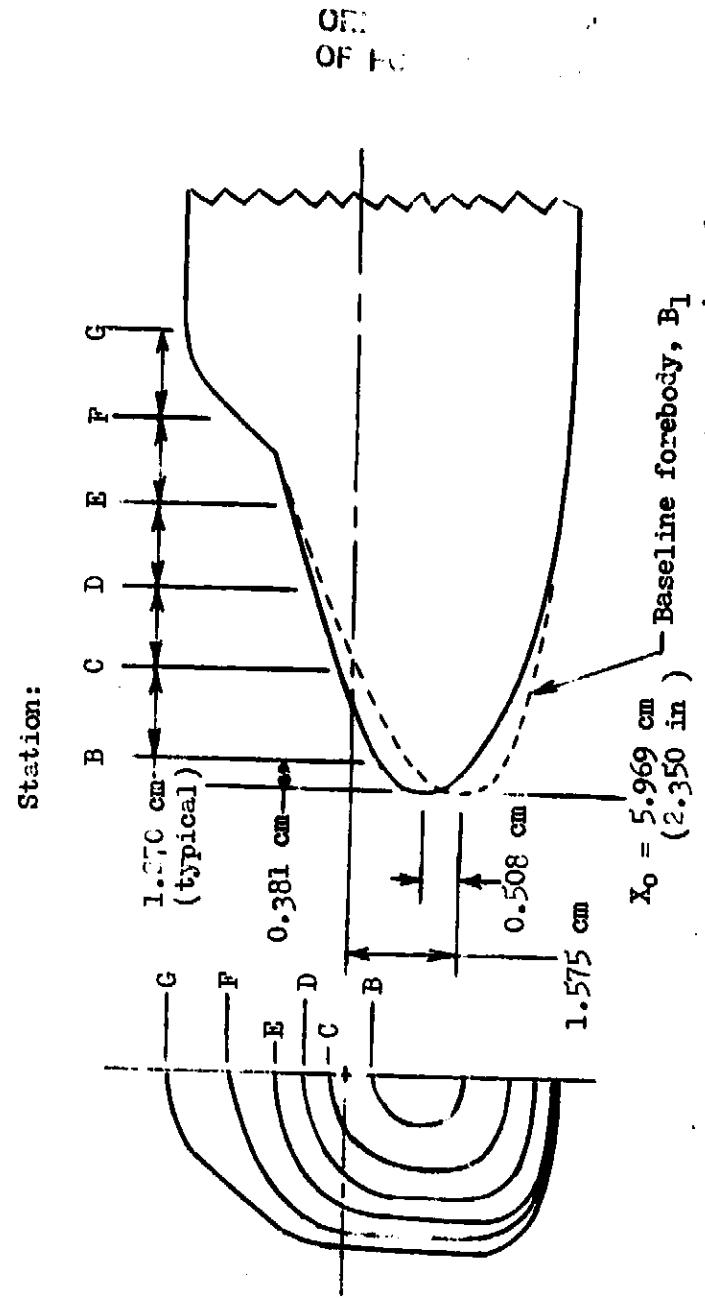
(b) Forebody B_2

Figure 1.- Continued.

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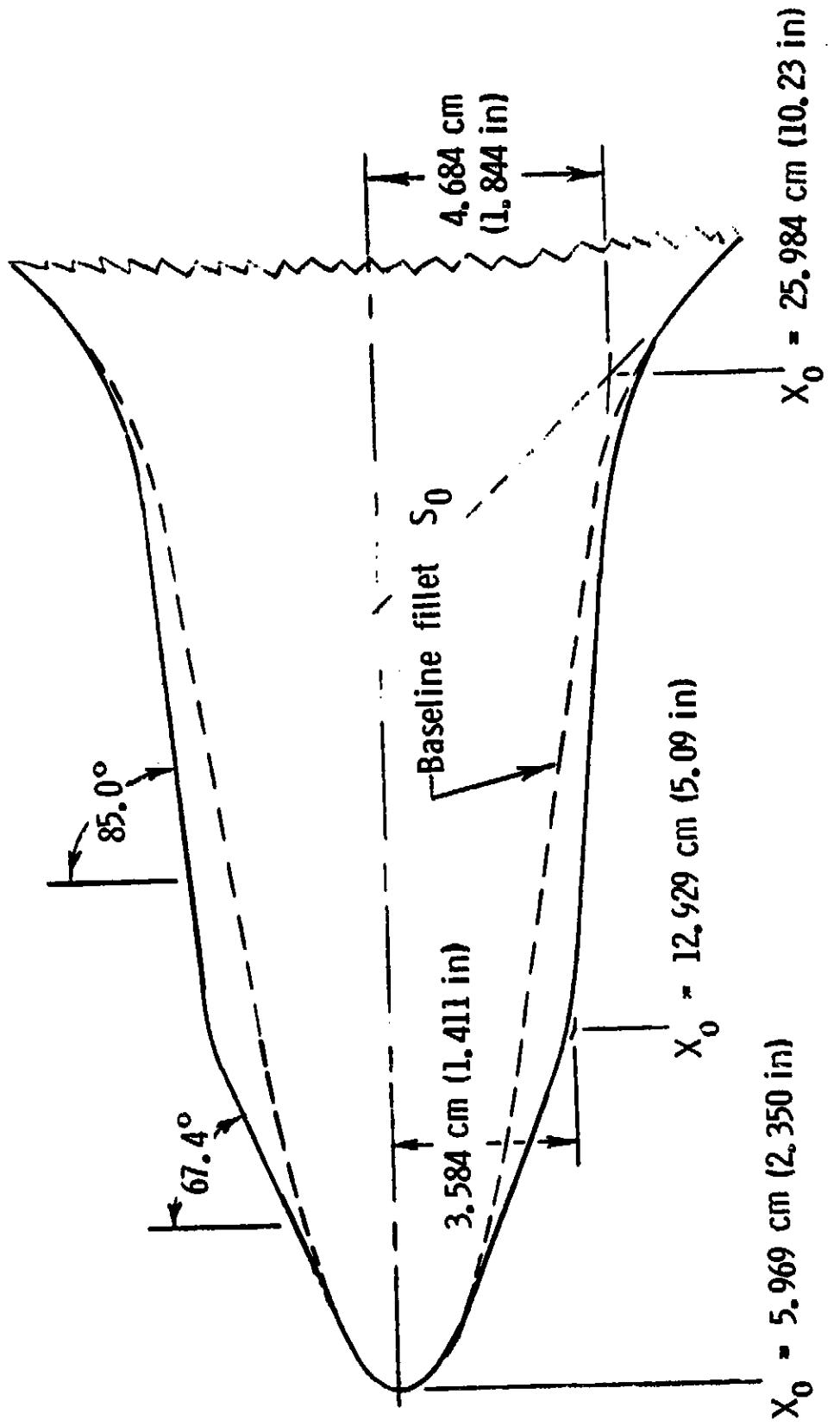
(c) Fillet S_2 (Configuration B_1WVS_2EF)

Figure 1. - Continued.

$X_0 = 13.480$ cm (5.307 in)

$X_0 = 17.775$ cm (6.998 in)

55.0^0

5.654 cm (2.226 in)

$X_0 = 5.969$ cm (2.350 in)

Canard C_3 (Configuration $B_1WVS_0C_3EF$)

Section AA (Typical)

$X_0 = 13.470$ cm (5.303 in)

A

A

54.7^0

6.406 cm (2.522 in)

$X_0 = 5.969$ cm (2.350 in)

$X_0 = 18.771$ cm (7.390 in)

Canard C_4 (Configuration $B_1WVS_0C_4EF$)
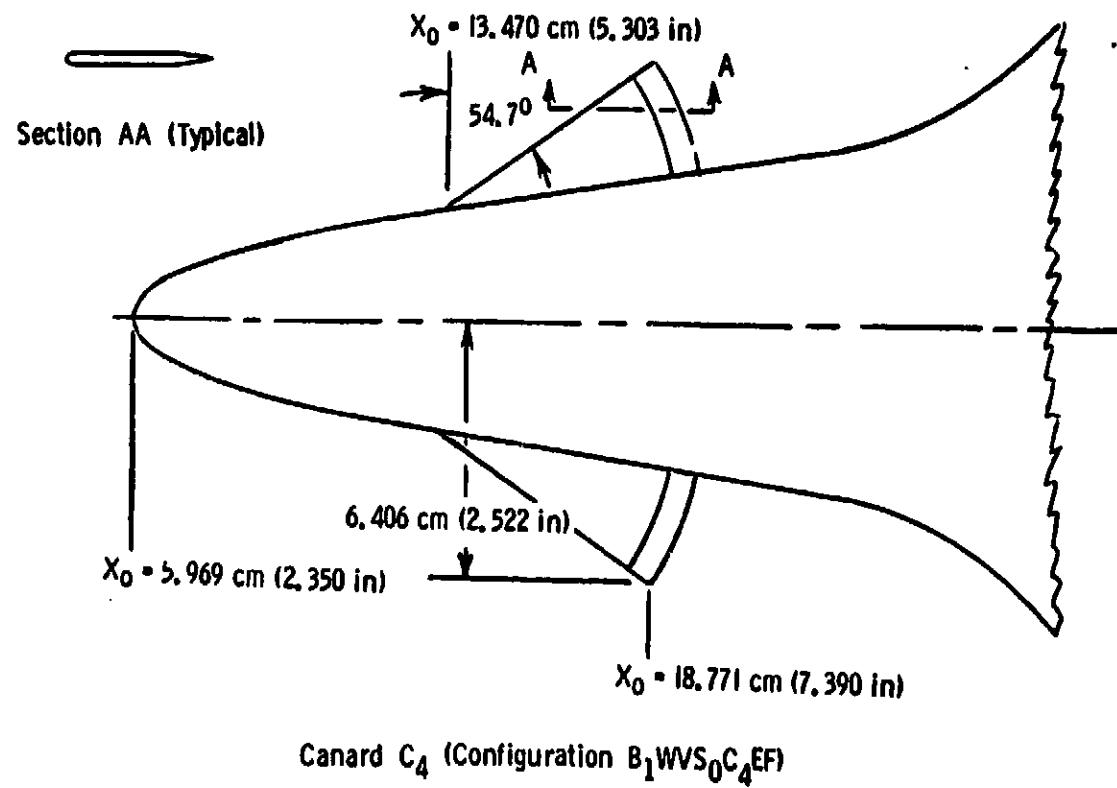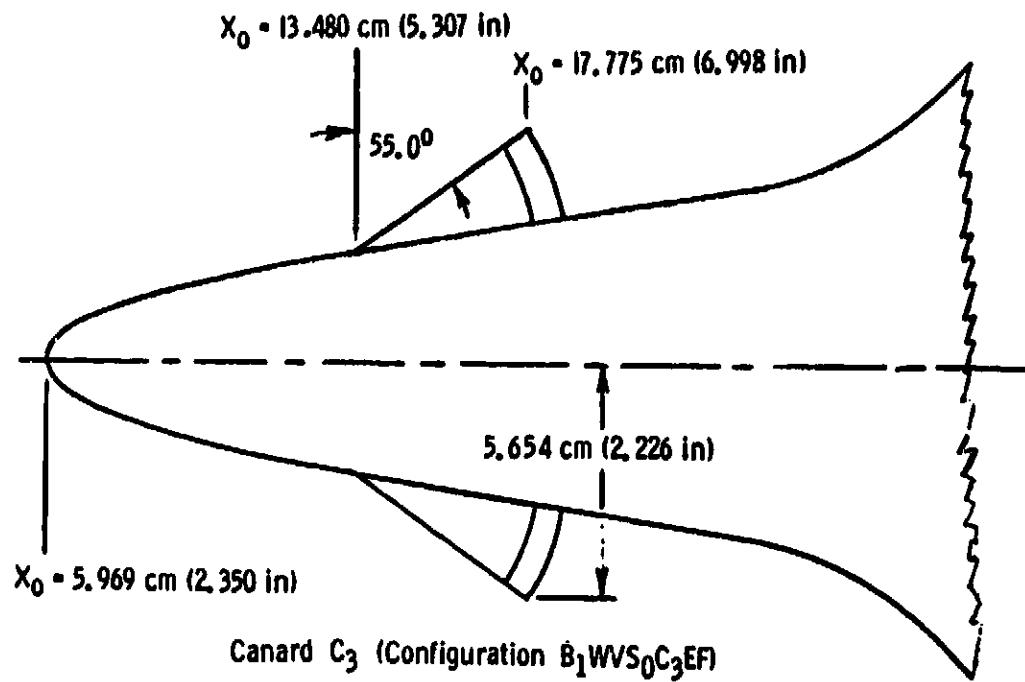
(d) Canards C_3 and C_4

Figure 1. - Continued.
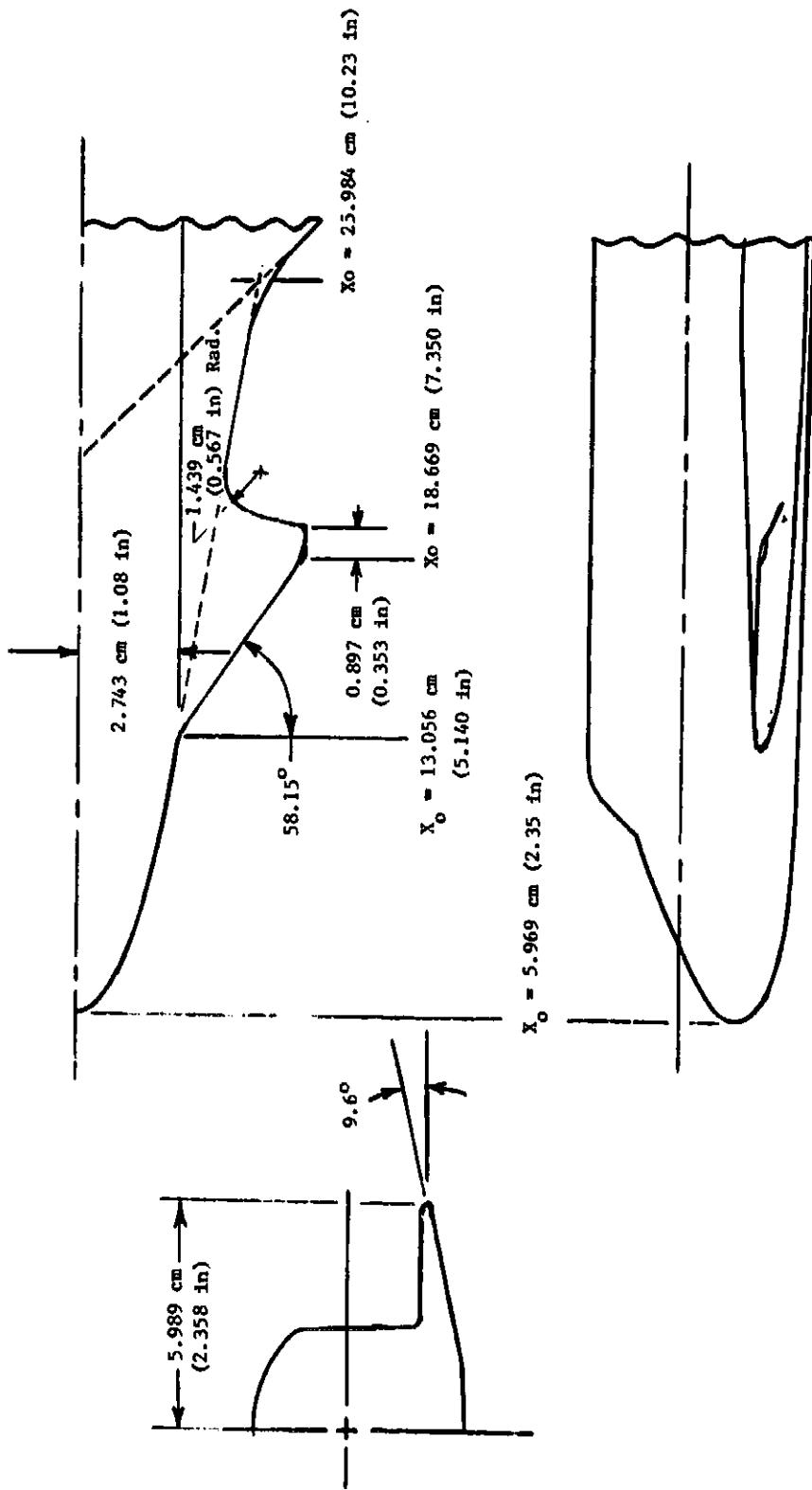
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(e) Canard C$_5$

Figure 1. – Concluded.

Xo = 25.984 cm (10.23 in)

Xo = 18.669 cm (7.350 in)

X_o = 13.056 cm (5.140 in)

X_o = 5.969 cm (2.35 in)

1.439 cm (0.567 in) Rad.

2.743 cm (1.08 in)

0.897 cm (0.353 in)

58.15°

9.6°

5.989 cm (2.358 in)

(c) Modified model with S_2 fillet
(Configuration B_1WVS_2EF)

Figure 2.- Concluded.
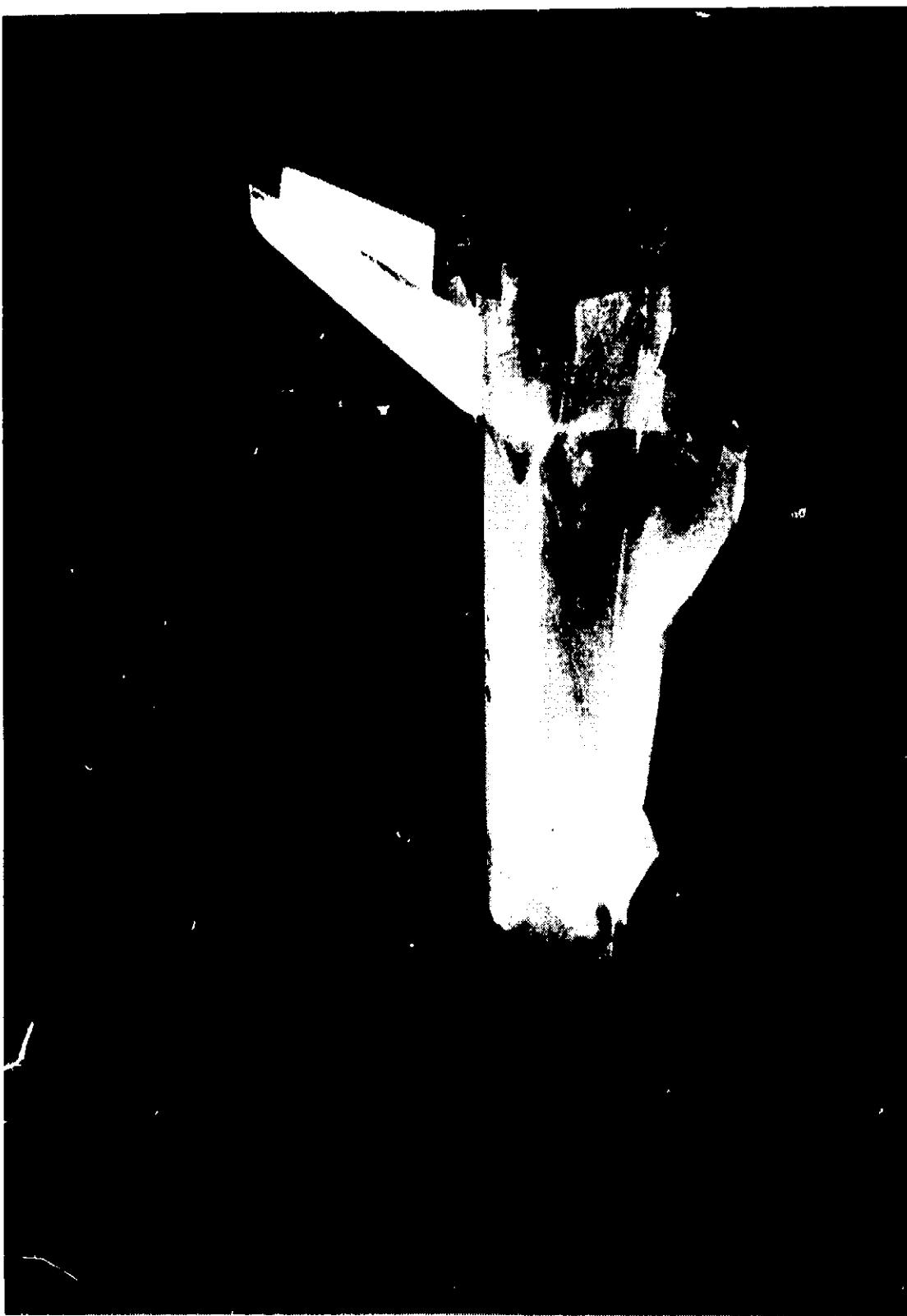
(b) Modified model with C_3 canard
(Configuration $B_1WS_0C_3EF$)

Figure 2.- Continued.
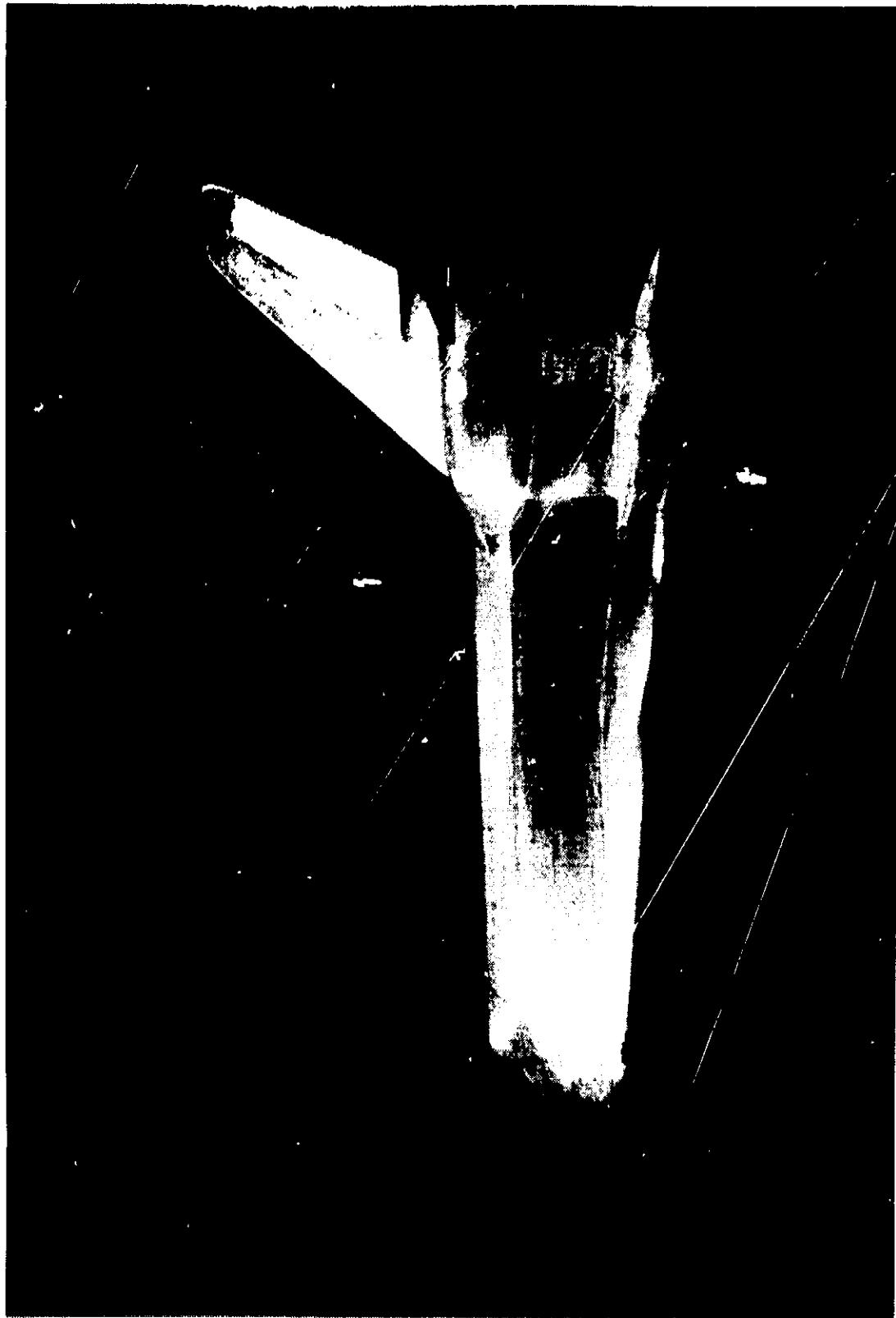
(a) Baseline 140A/B Orbiter Model (Configuration B_1WVS_0EF).

Figure 2.- Photographs of several test configurations.
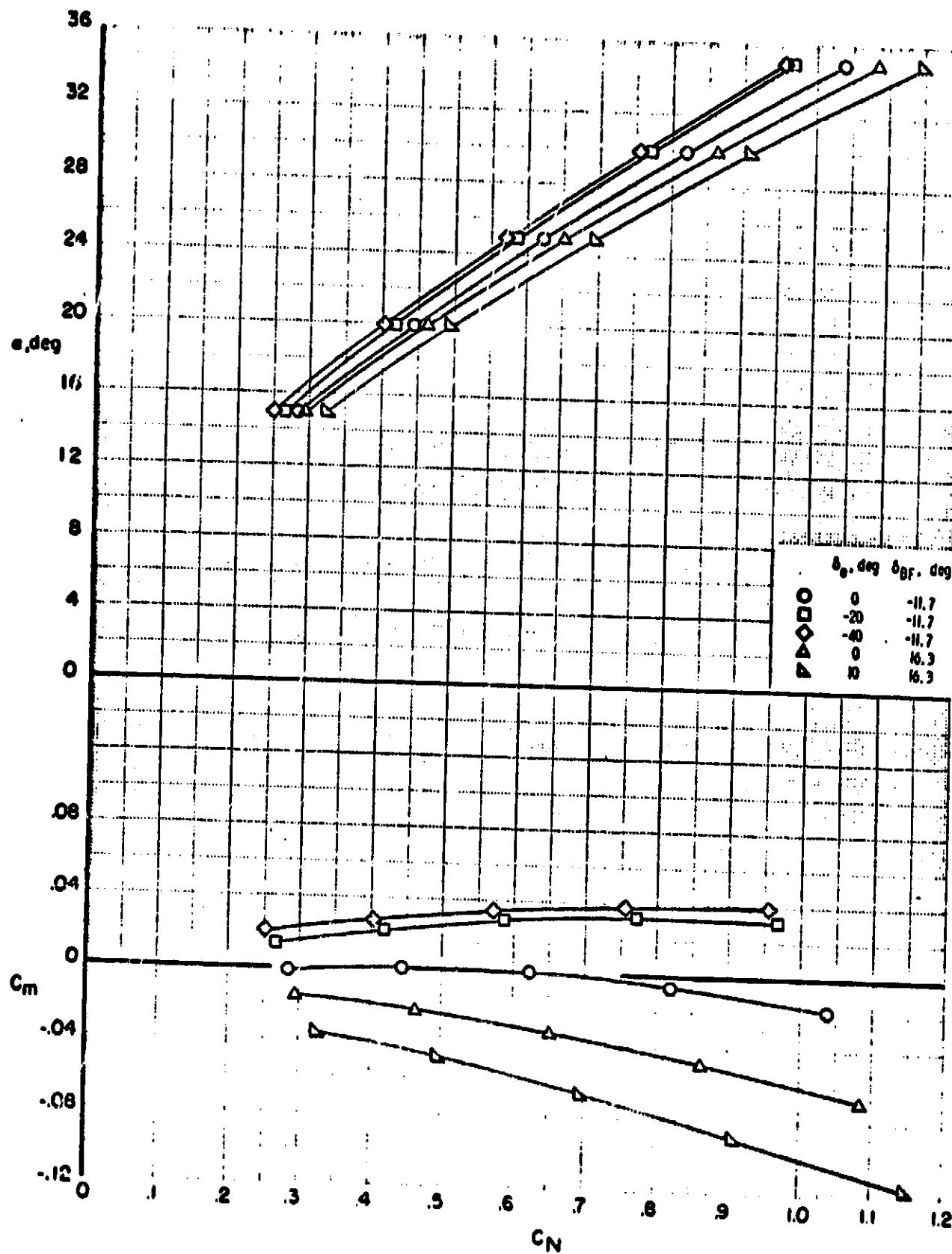
Figure 3. - Longitudinal aerodynamic characteristics for the baseline configuration B_1WVS_0EF. $\delta_{SB} = 55°$
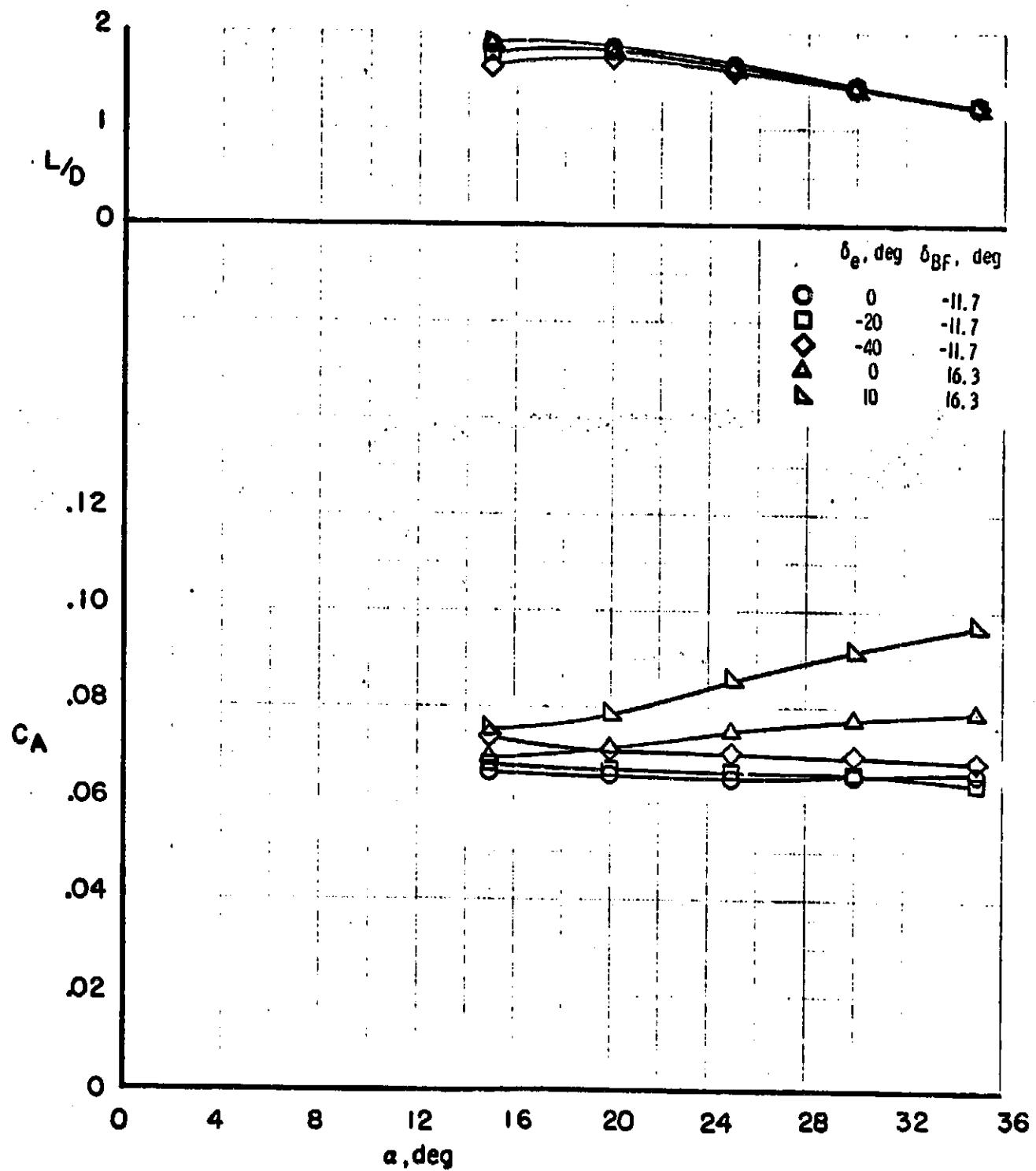
	δ_e, deg	δ_{BF}, deg
◐	0	-11.7
▢	-20	-11.7
◇	-40	-11.7
△	0	16.3
◮	10	16.3

Figure 3. - Concluded.

Forebody	δ_e, deg	δ_{BF}, deg
B_1	-40	-11.7
B_2	-40	-11.7
B_1	10	16.3
B_2	10	16.3

(a) concluded.

Figure 4. - Continued.

forebody	δ_e, deg	δ_{BF}, deg
B_1	-40	-11.7
B_2	-40	-11.7
B_1	10	16.3
B_2	10	16.3
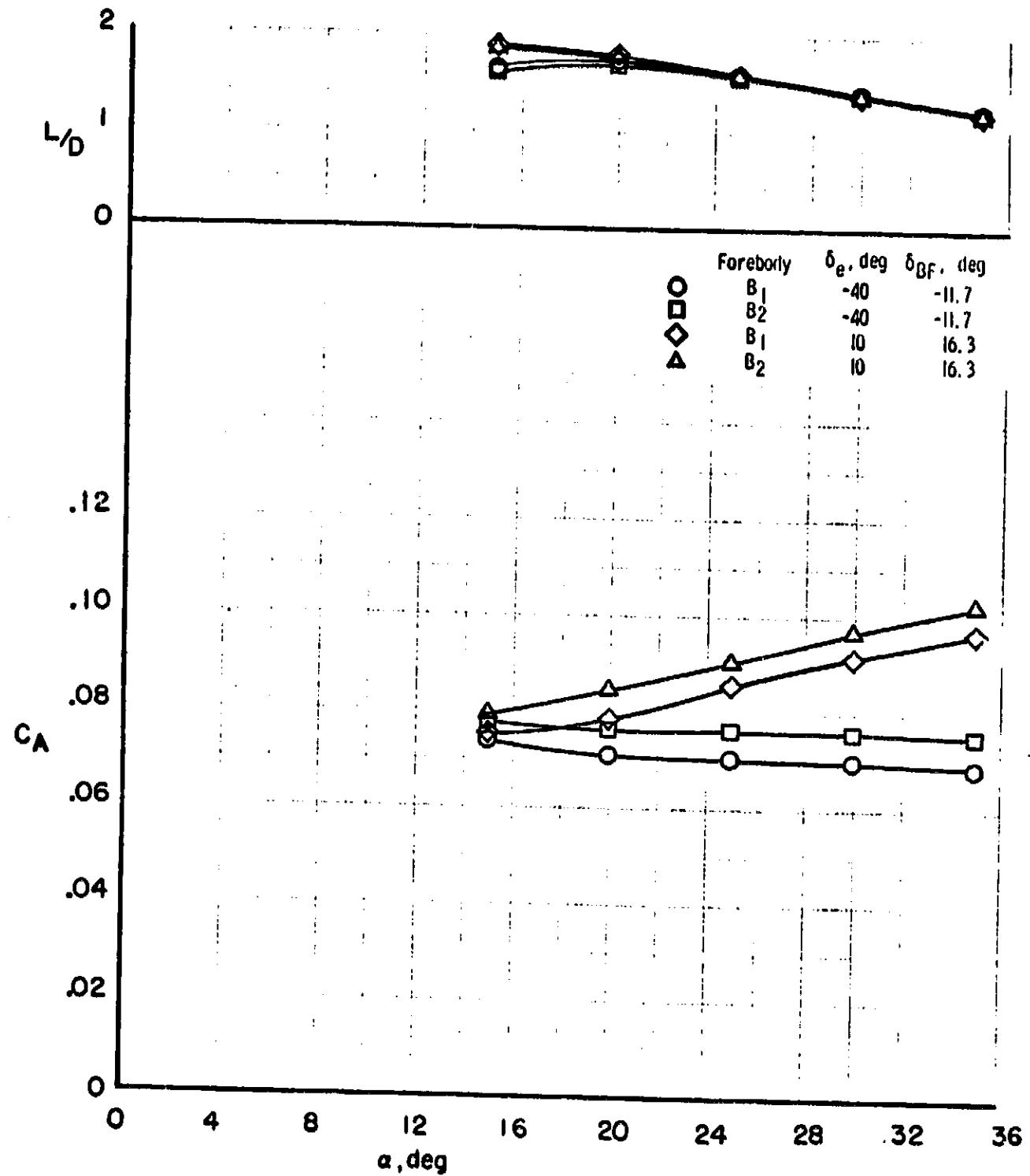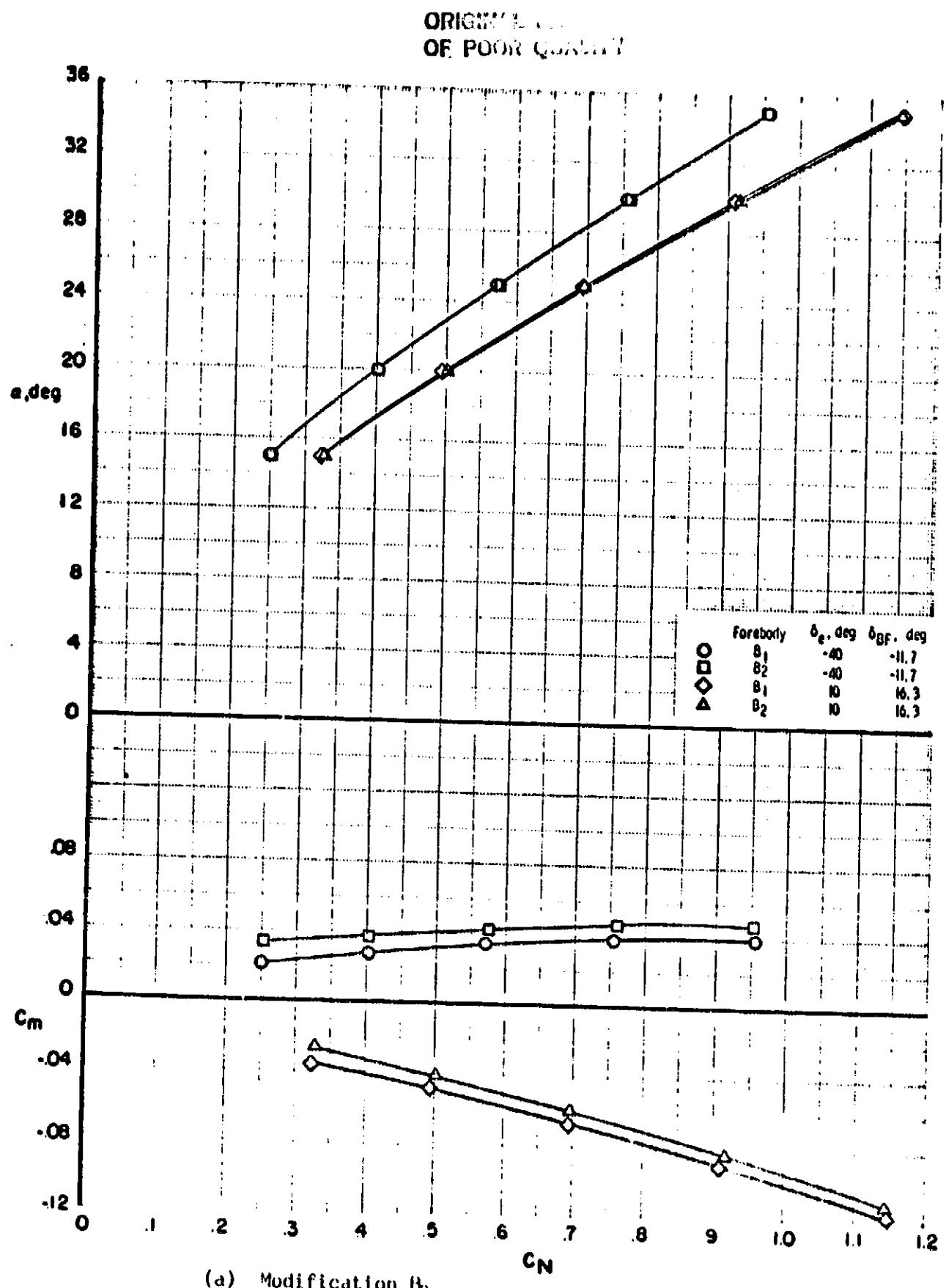
(a) Modification B_2

Figure 4. - Effects of configuration modifications on the longitudinal aerodynamic characteristics of the baseline configuration. $\delta_{SB} = 55°$

Fillet	δ_e, deg	δ_{BF}, deg
○ S_0	-40	-11.7
□ S_2	-40	-11.7
◇ S_0	10	16.3
△ S_2	10	16.3
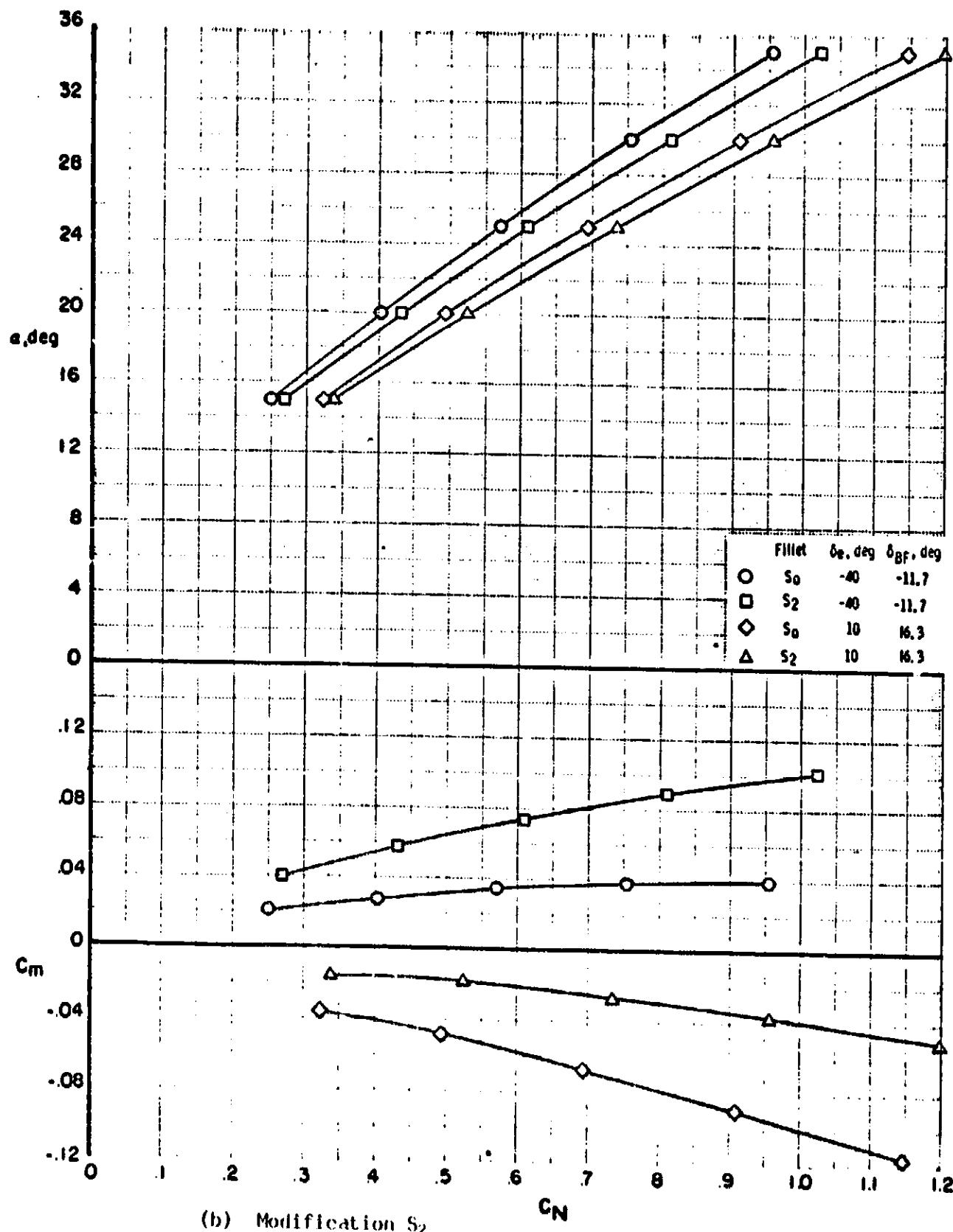
(b)   Modification S_2

Figure 4. - Continued.

(b) Concluded.

Figure 4. - Continued.

	Forebody	Fillet	δ_e, deg	δ_{BF}, deg
○	B_1	S_0	-40	-11.7
□	B_2	S_2	-40	-11.7
◇	B_1	S_0	10	16.3
△	B_2	S_2	10	16.3
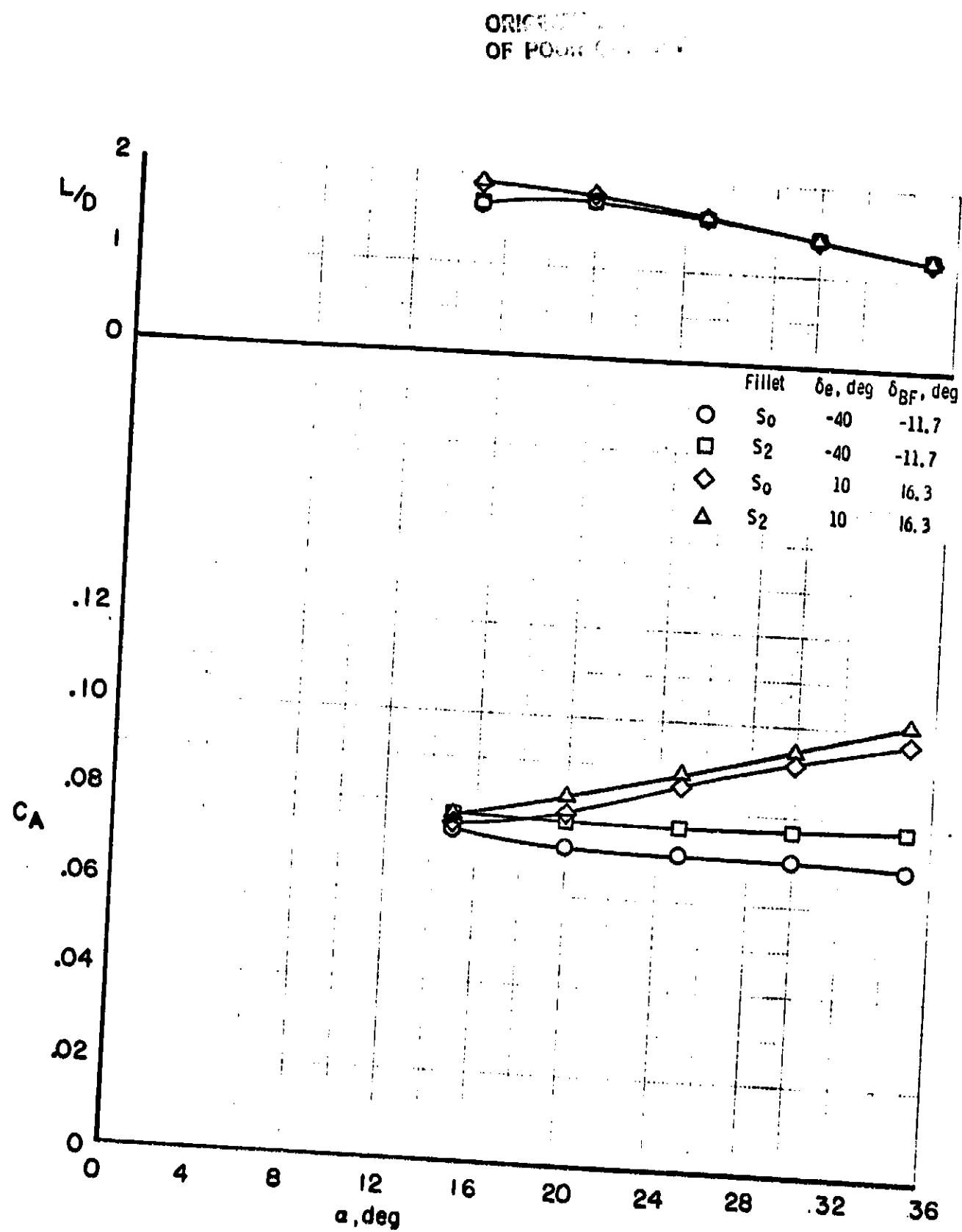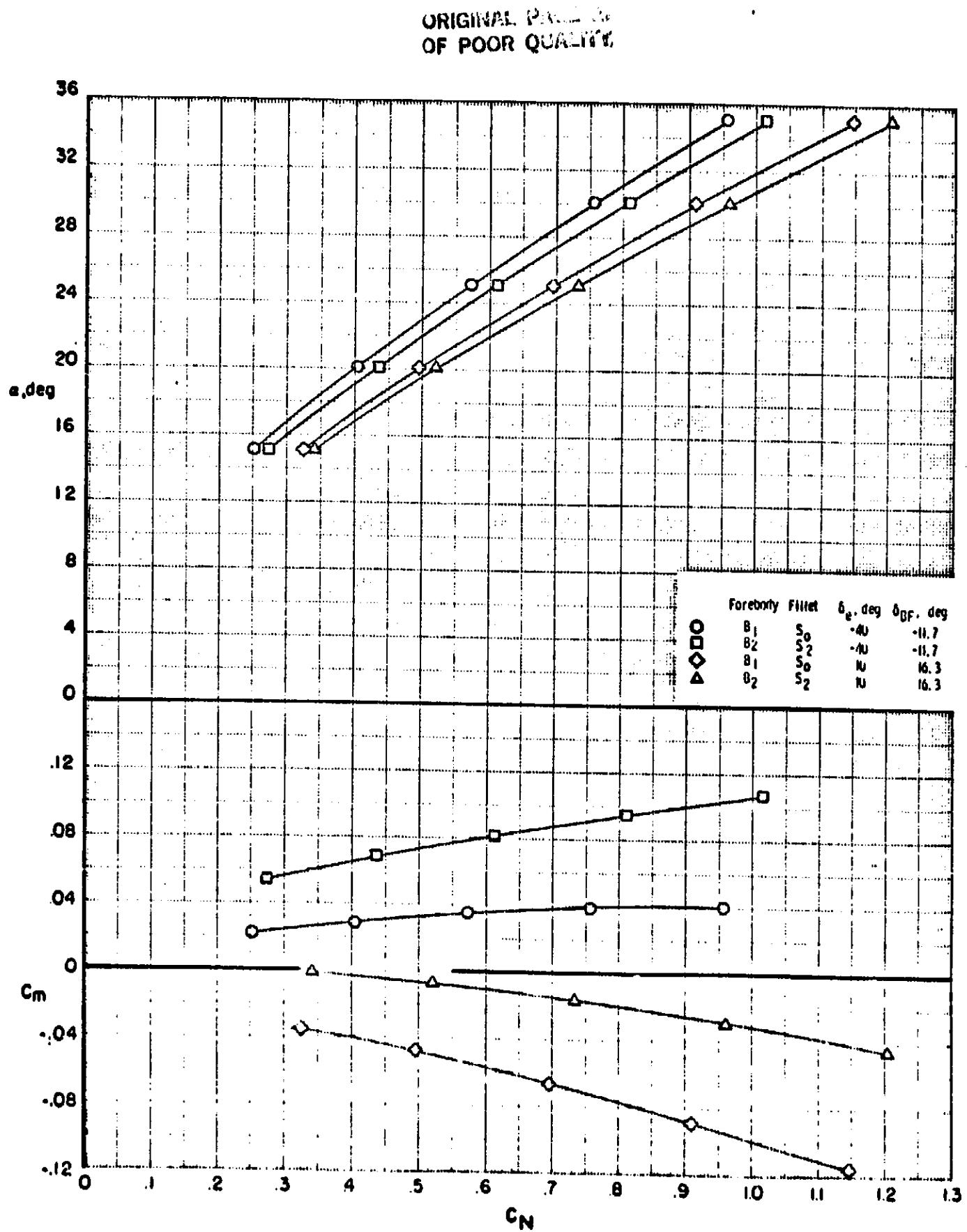
(c)   Modification $B_2 S_2$

Figure 4. - Continued.

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	Forebody	Fillet	δ_e, deg	δ_{BF}, deg
○	B_1	S_0	-40	-11.7
□	B_2	S_2	-40	-11.7
◇	B_1	S_0	10	16.3
△	B_2	S_2	10	16.3

(c) Concluded.

Figure 4. - Continued.

Canard	δ_e, deg	δ_{BF}, deg
○ off	-40	-11.7
□ C_3	-40	-11.7
◇ off	10	16.3
△ C_3	10	16.3
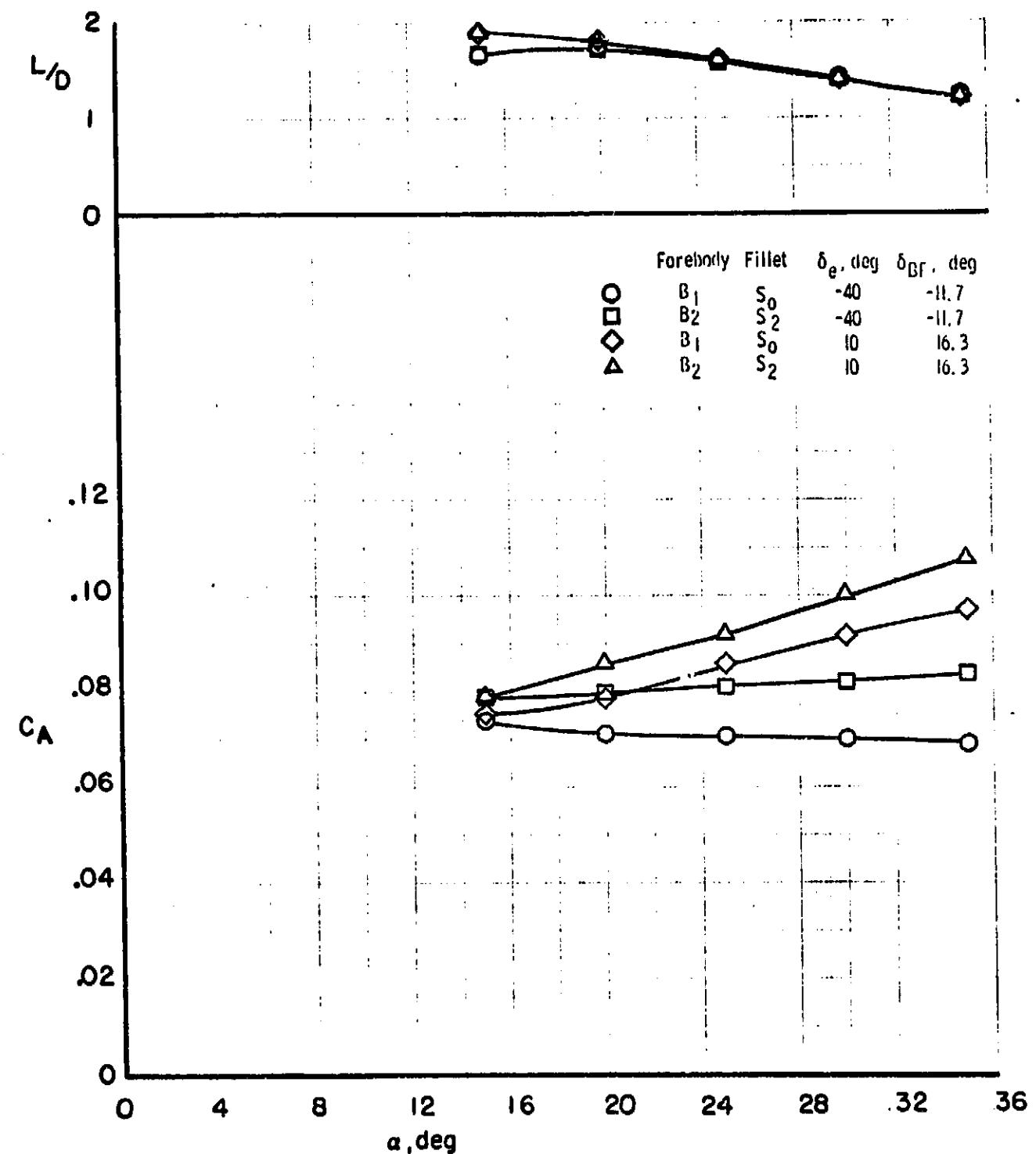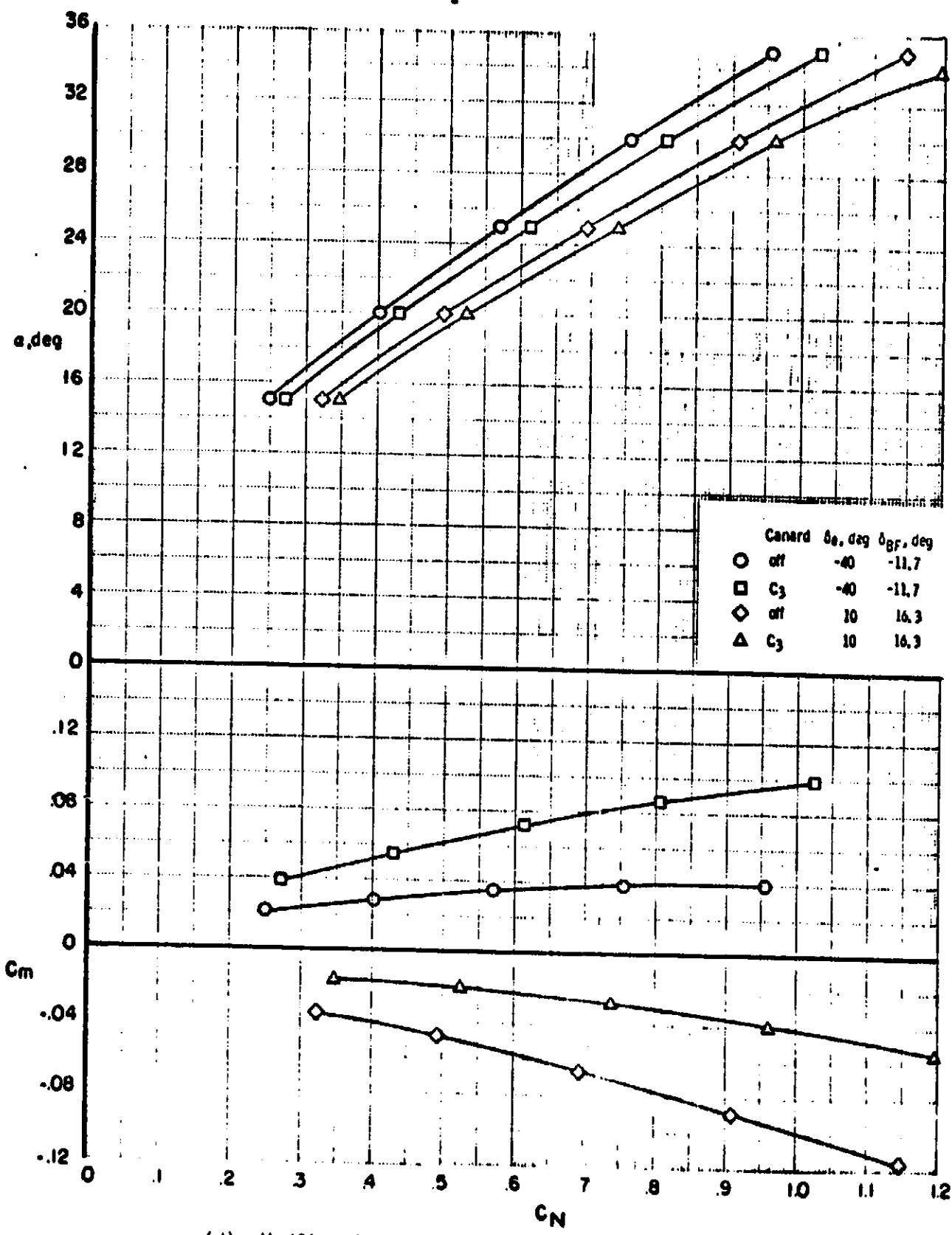
(d)   Modfication C_3

Figure 4. - Continued.

(d) Concluded.

Figure 4. - Continued.

	Forebody	Canard	δ_e, deg	δ_{BF}, deg
○	B_1	off	-40	-11.7
□	B_2	C_3	-40	-11.7
◇	B_1	off	10	16.3
△	B_2	C_3	10	16.3
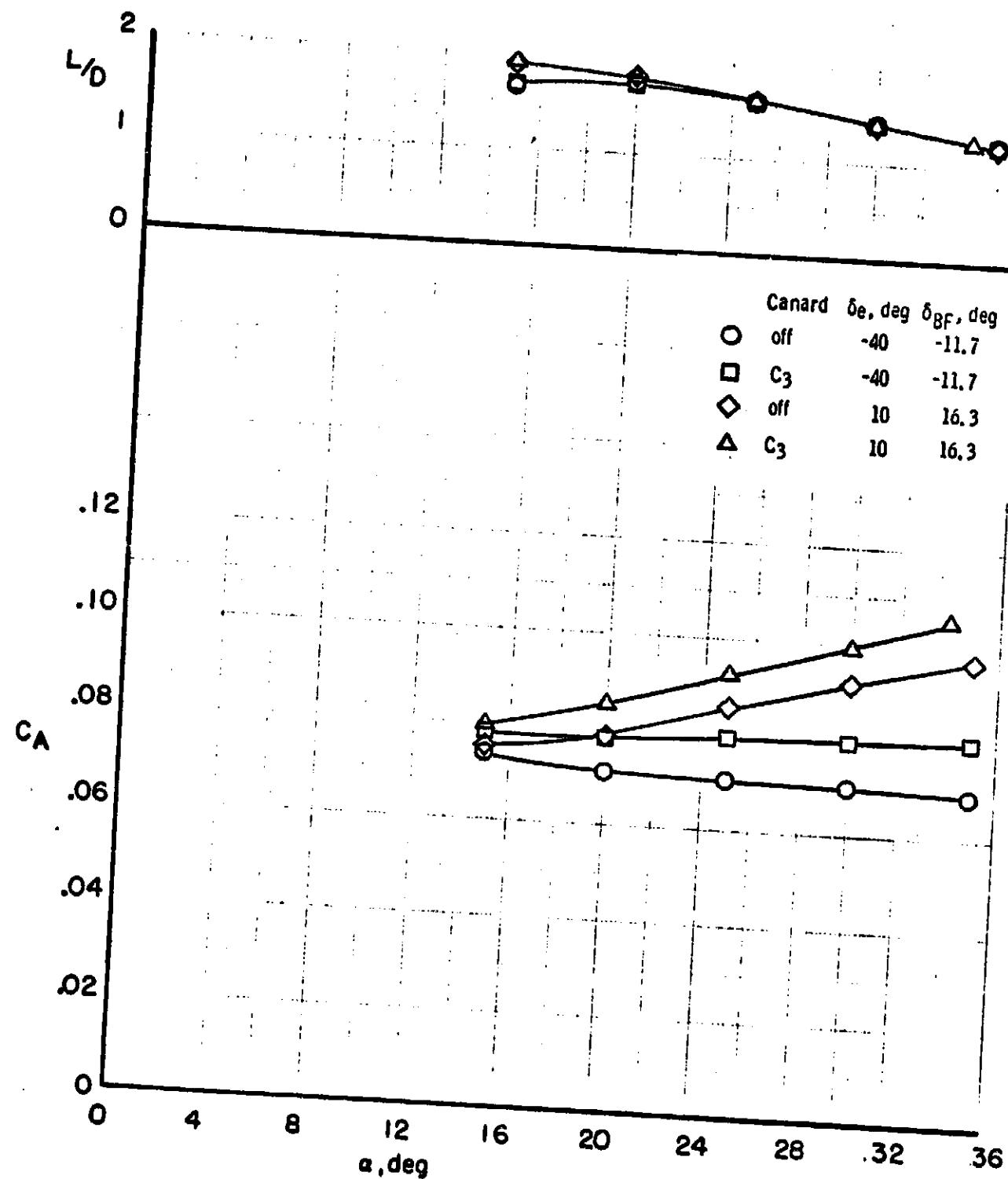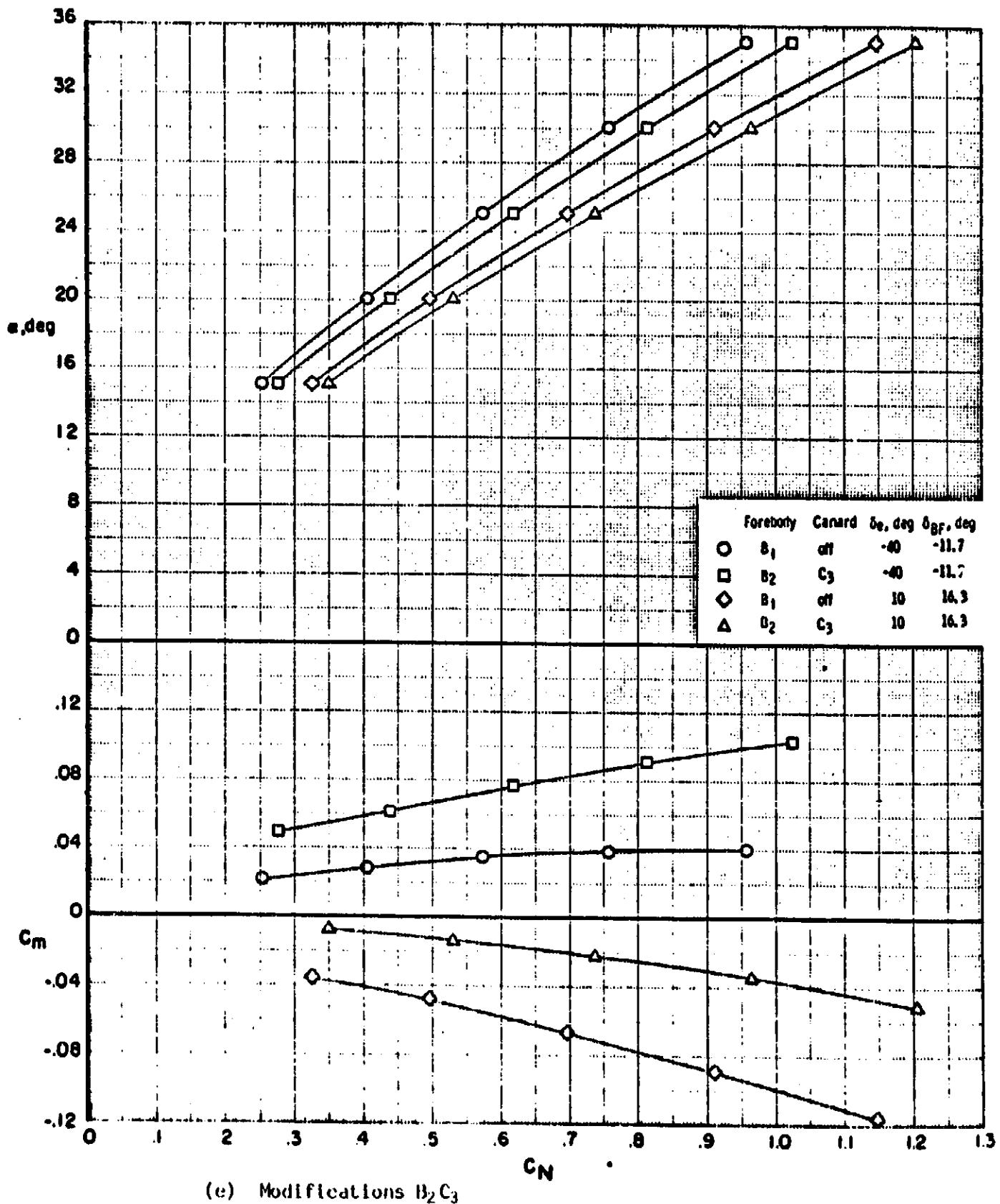
(e) Modifications $B_2 C_3$

Figure 4. - Continued.
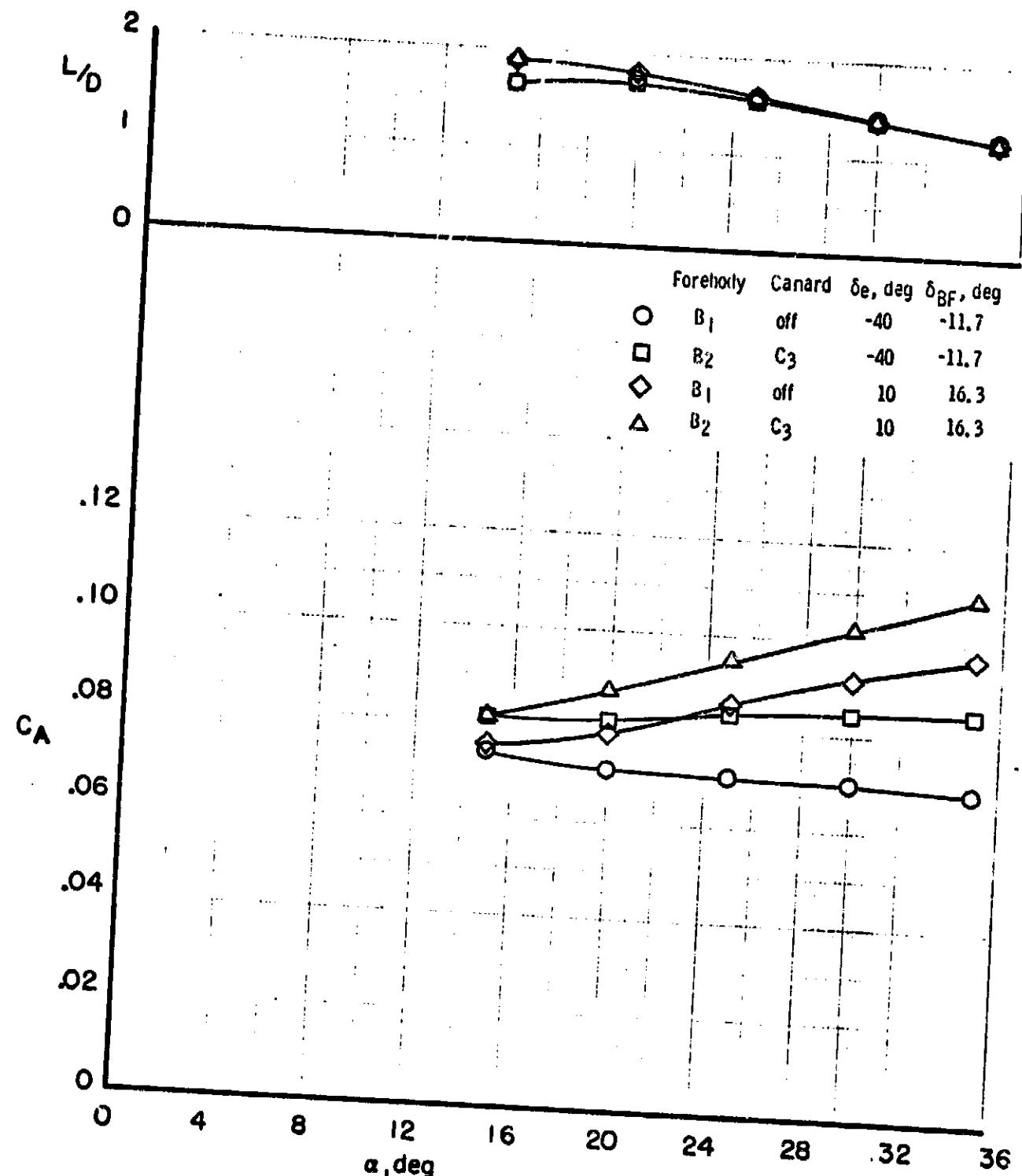
32

(e) Concluded.

Figure 4. - Continued.
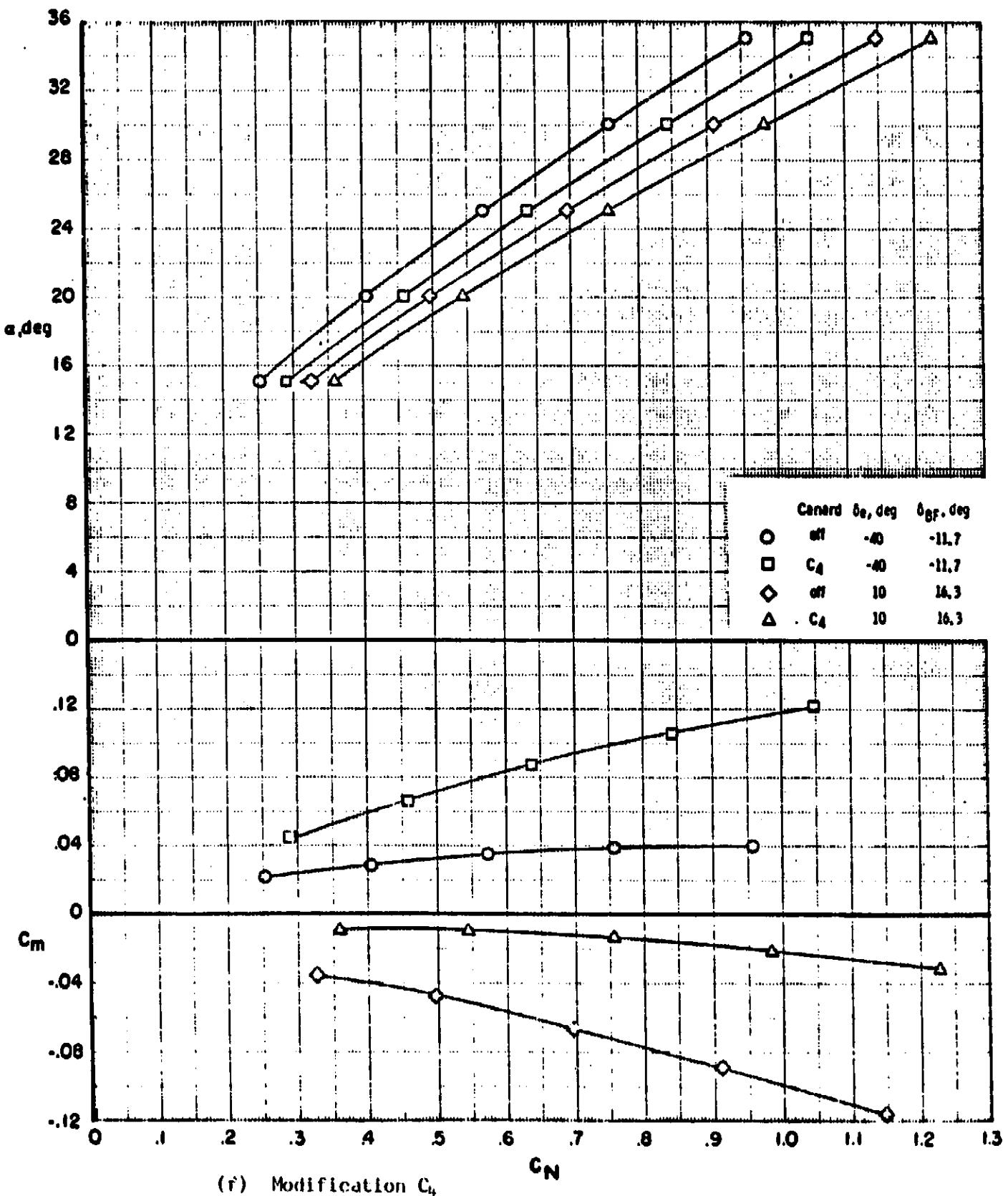
Canard	δ_e, deg	δ_{BF}, deg
○ off	-40	-11.7
□ C_4	-40	-11.7
◇ off	10	16.3
△ C_4	10	16.3

(f)   Modification C_4

Figure 4. - Continued.

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	Canard	δ_e, deg	δ_{BF}, deg
○	off	-40	-11.7
□	C_4	-40	-11.7
◇	off	10	16.3
△	C_4	10	16.3

(f) Concluded.

Figure 4. - Continued.

(g) Modification C_5

Figure 4. - Continued.

	Canard	δ_e, deg	δ_{bf}, deg
○	off	-40	-11.7
□	C_5	-40	-11.7
◇	off	10	16.3
△	C_5	10	16.3
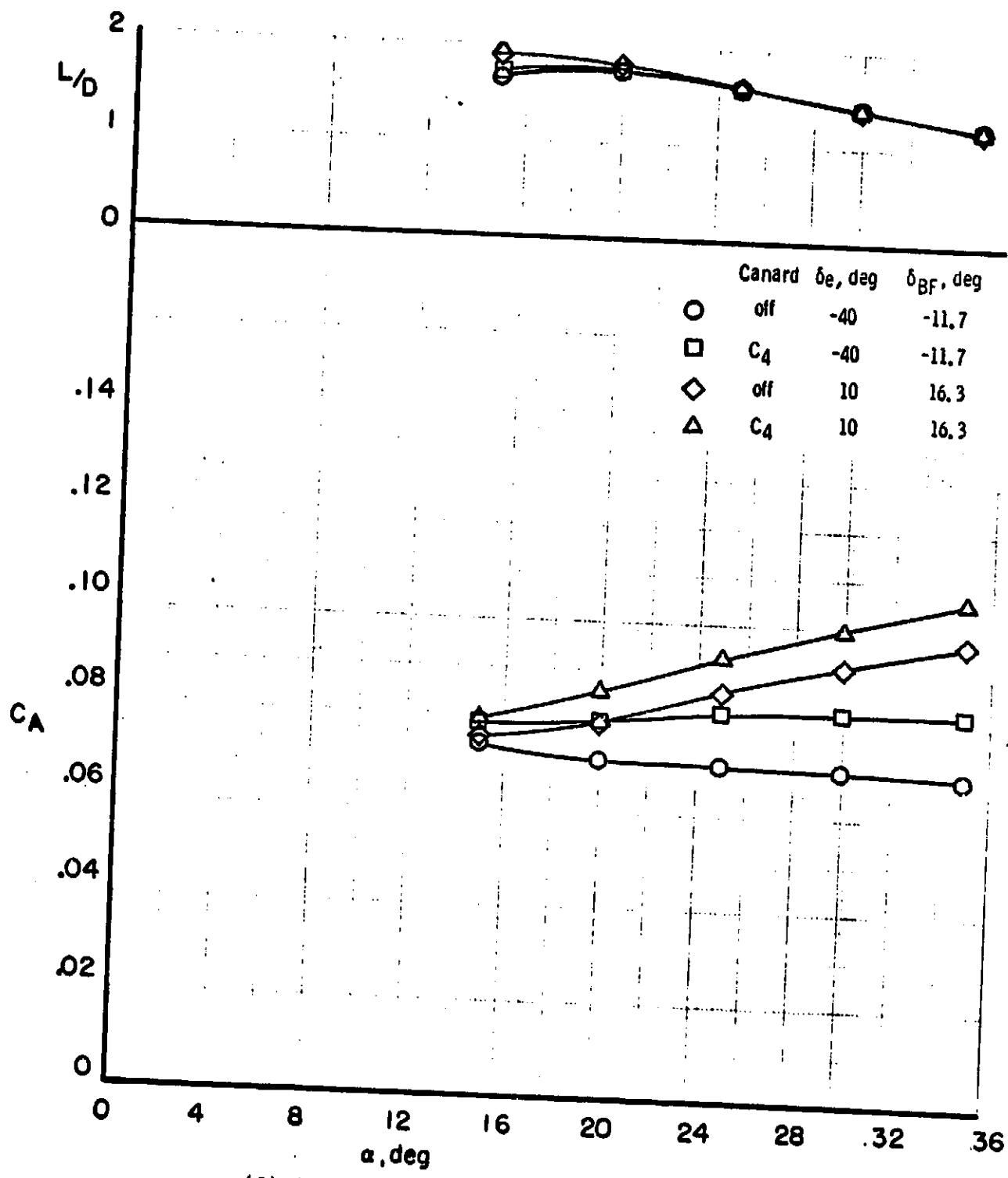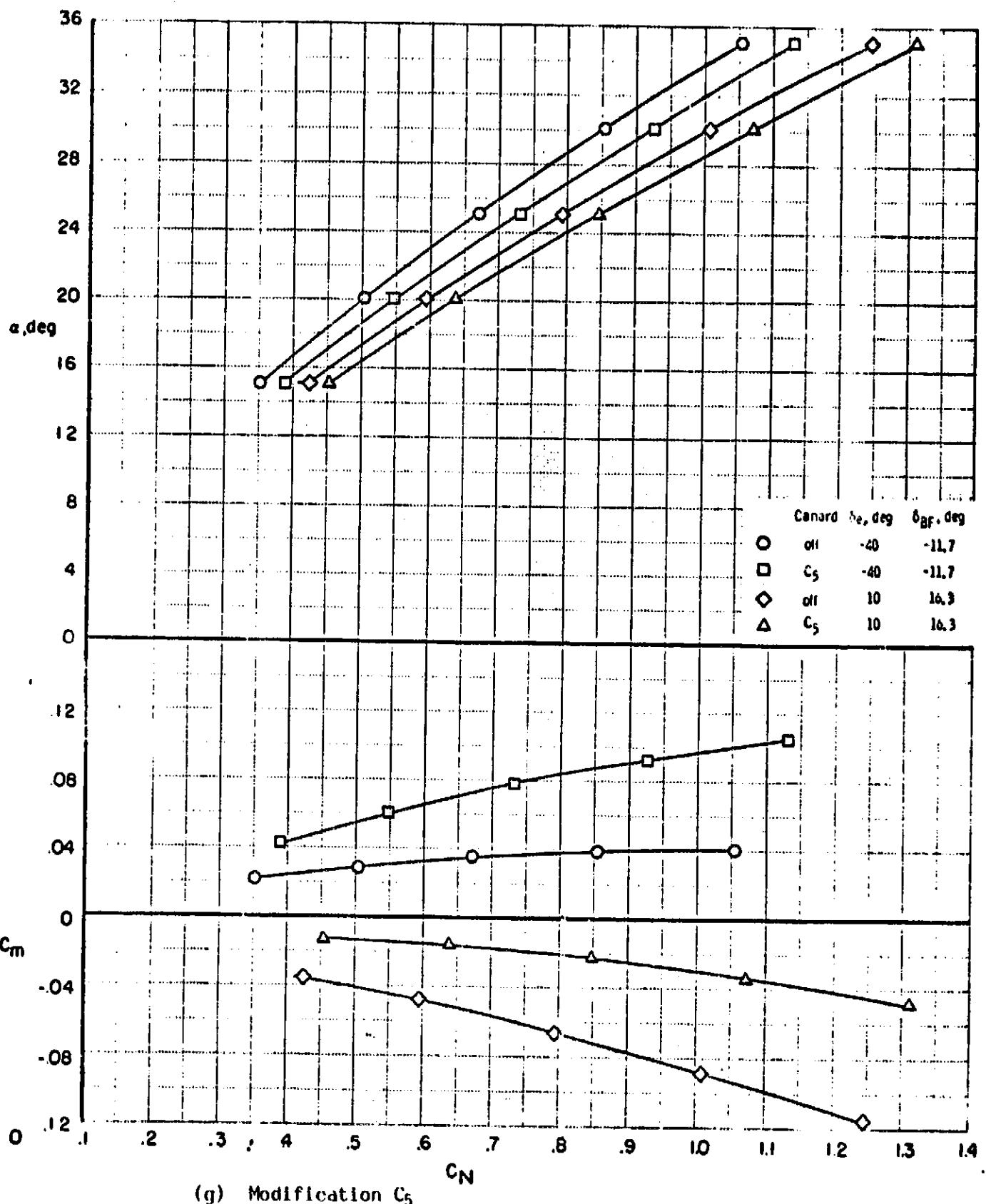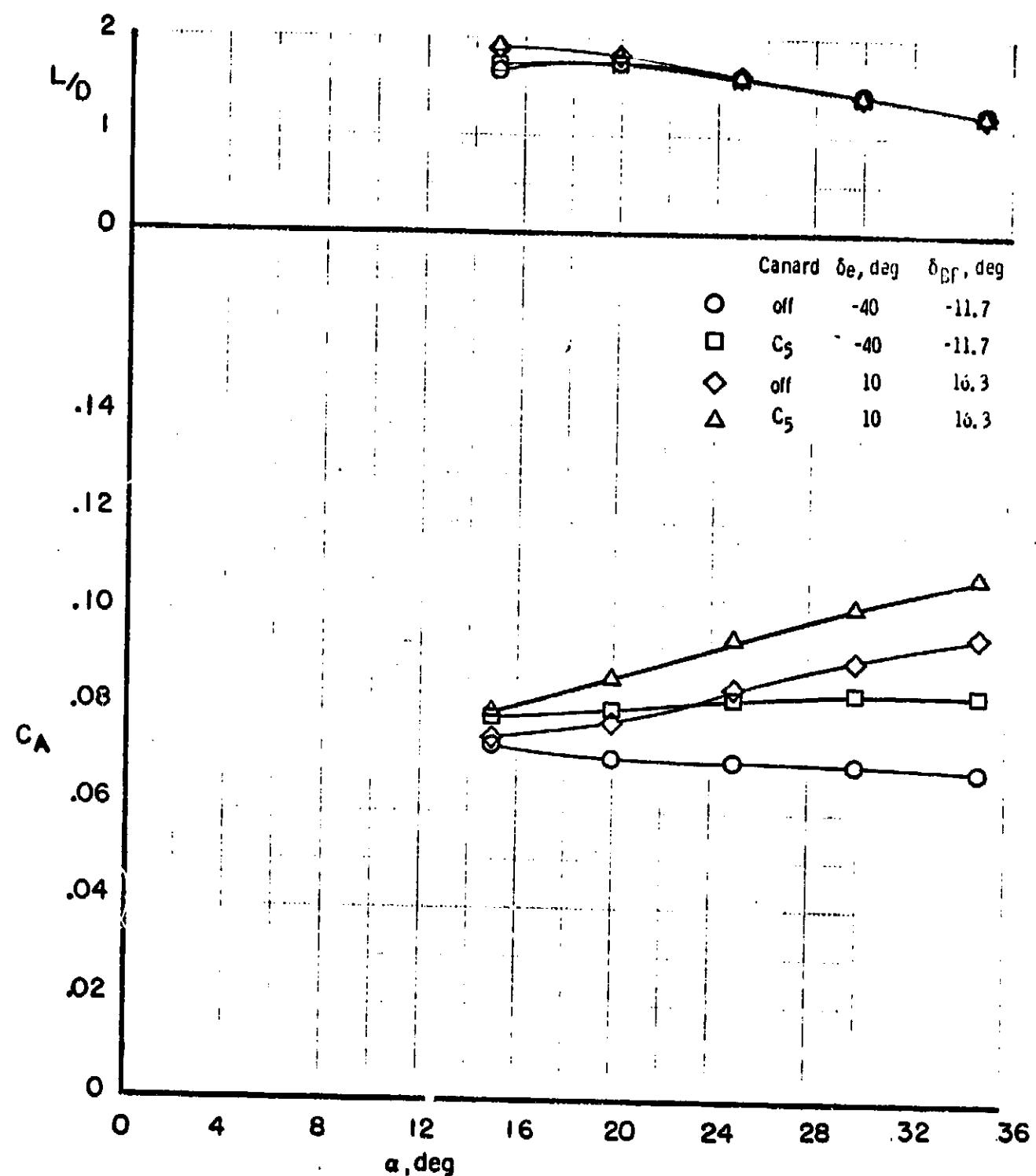
(g) Concluded.

Figure 4. - Concluded.

	δ_e, deg	δ_{BF}, deg
○	0	-11.7
□	-20	-11.7
◇	-40	-11.7
△	0	16.3
◭	10	16.3
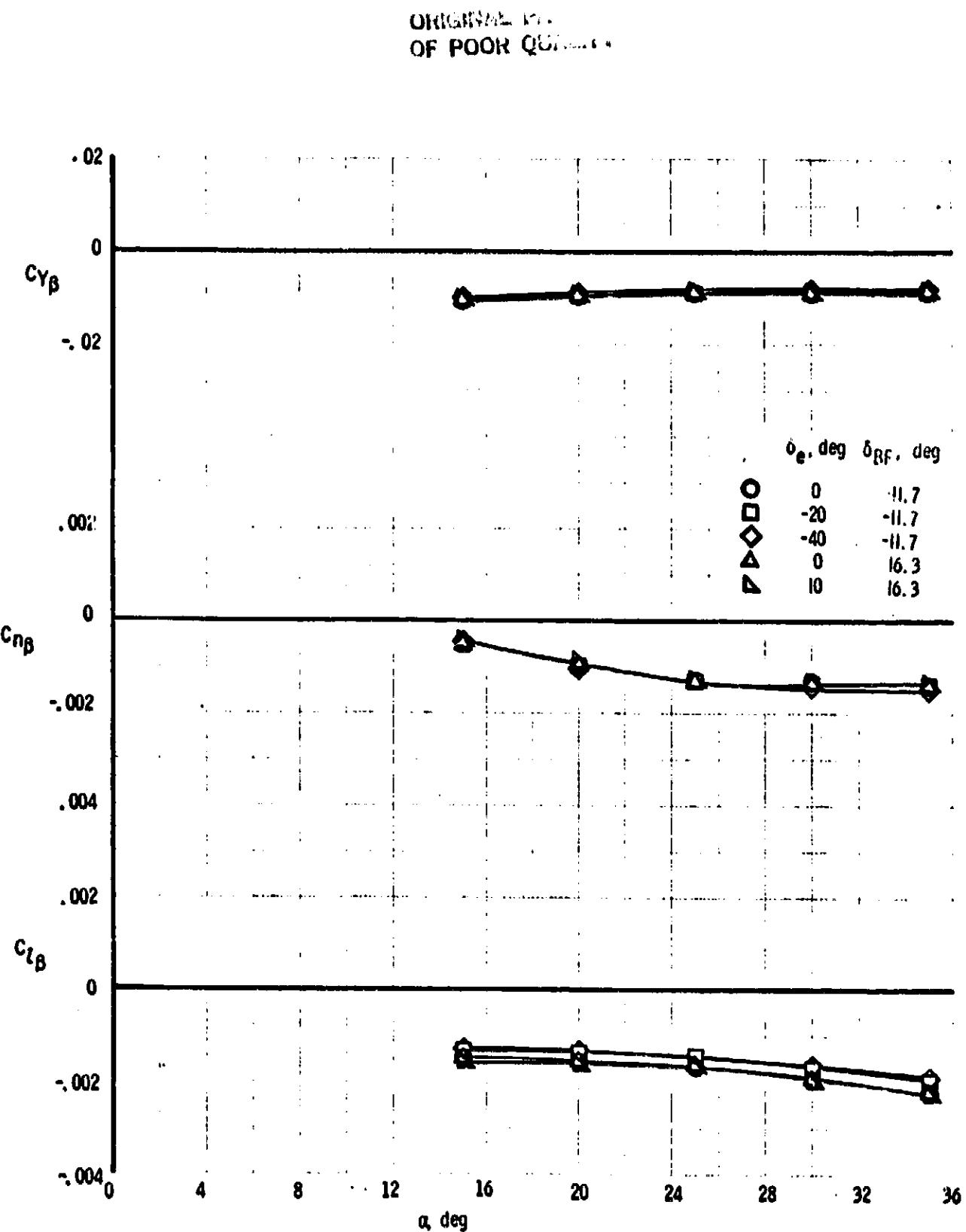
(a) Baseline configuration $B_1 WVS_0 EF$

Figure 5. - Lateral-directional aerodynamic characteristics for
the baseline configuration and modified
configurations. $\delta_{SB} = 55°$.

$.02$

C_{Y_β}

0

$-.02$

$.002$

	δ_e, deg	δ_{BF}, deg
◯	-40	-11.7
▢	10	16.3

C_{n_β} 0

$-.002$

$-.004$

$.002$

C_{l_β} 0

$-.002$

$-.004$

0 4 8 12 16 20 24 28 32 36

α, deg
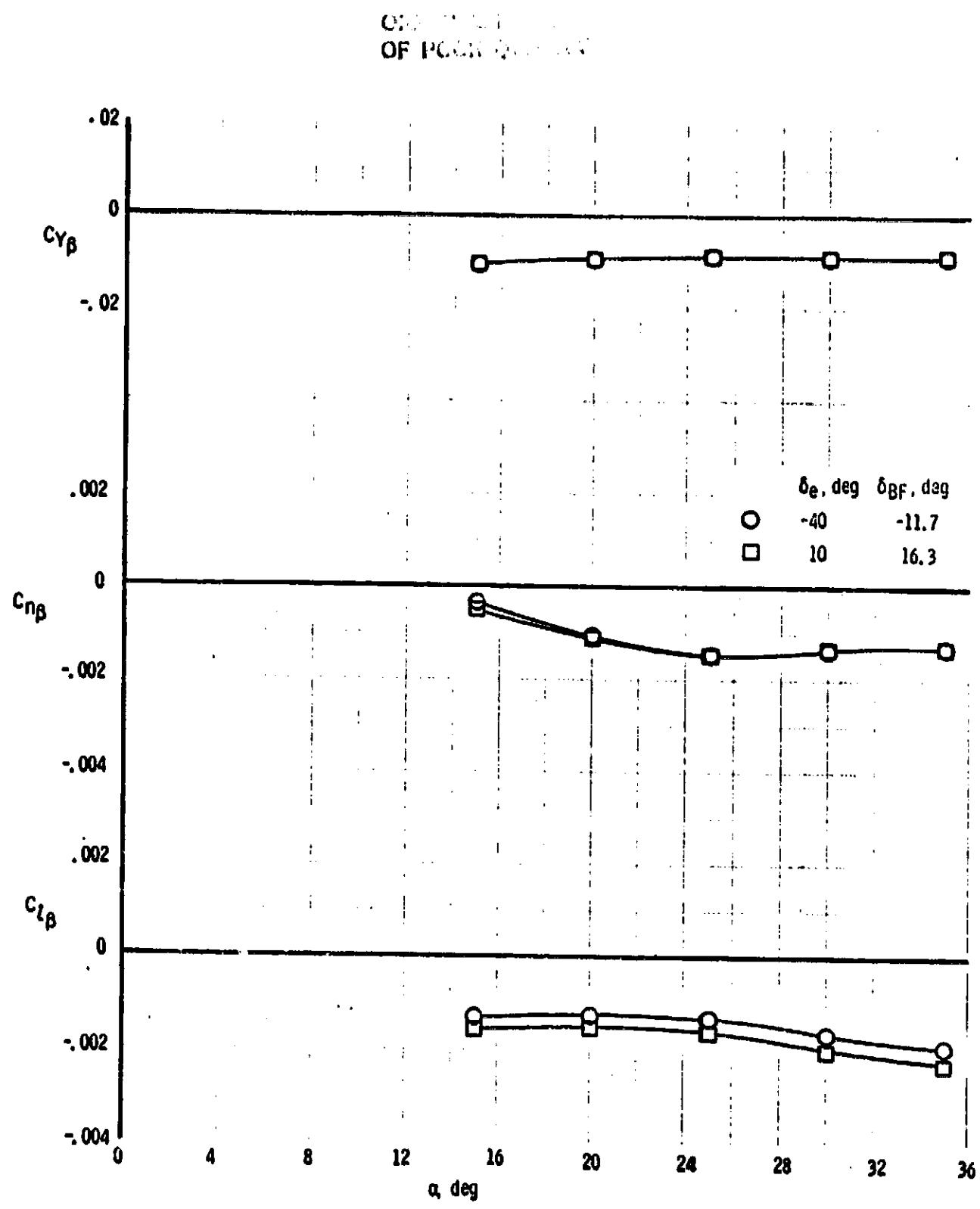
(b)   Configuration $B_2 WVS_0 EF$

Figure 5. - Continued.
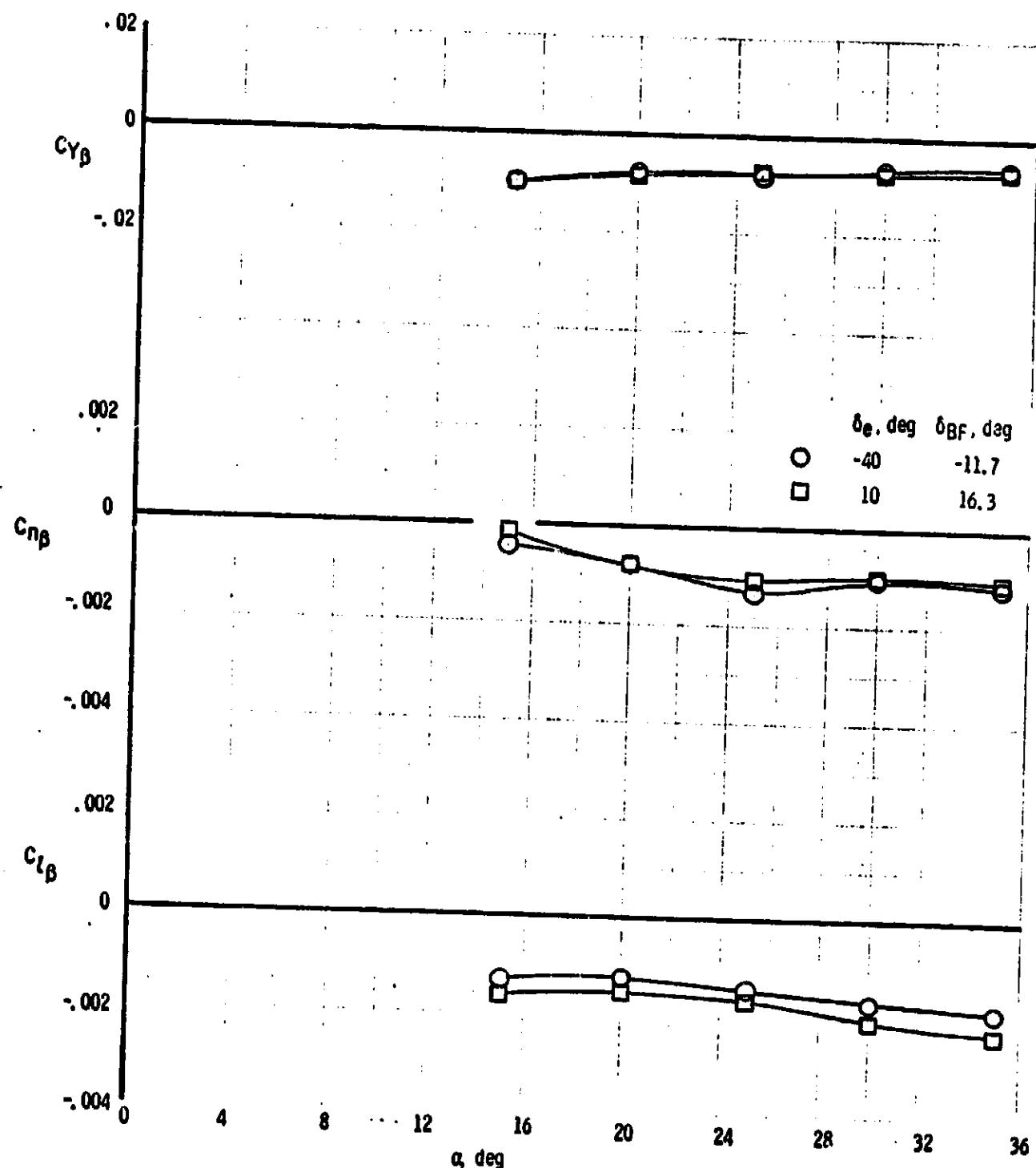
(c)   Configuration $B_1 WVS_2 E_F$
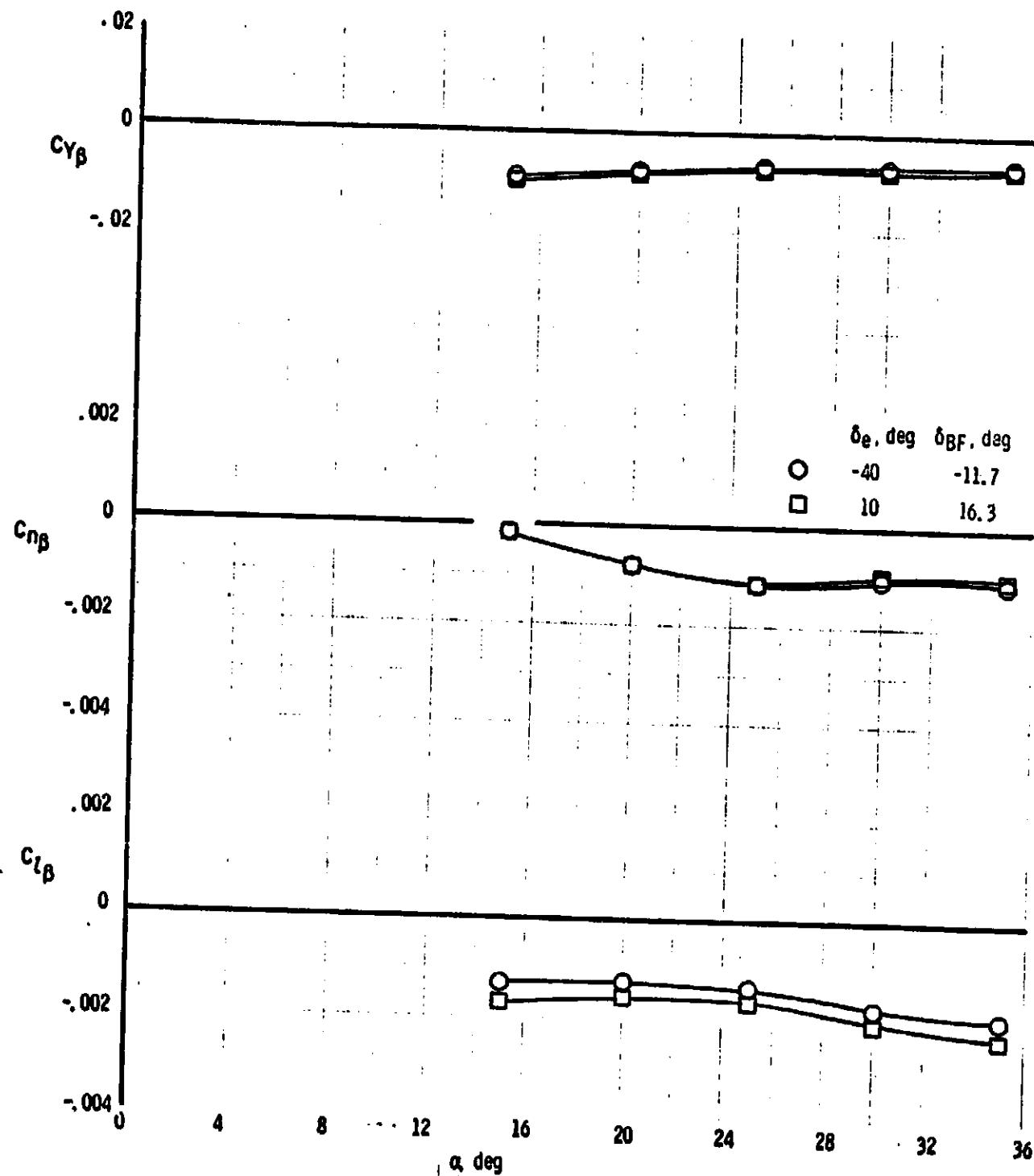
Figure 5. - Continued.

(d) Configuration $B_2 WVS_2 EF$

Figure 5. - Continued.
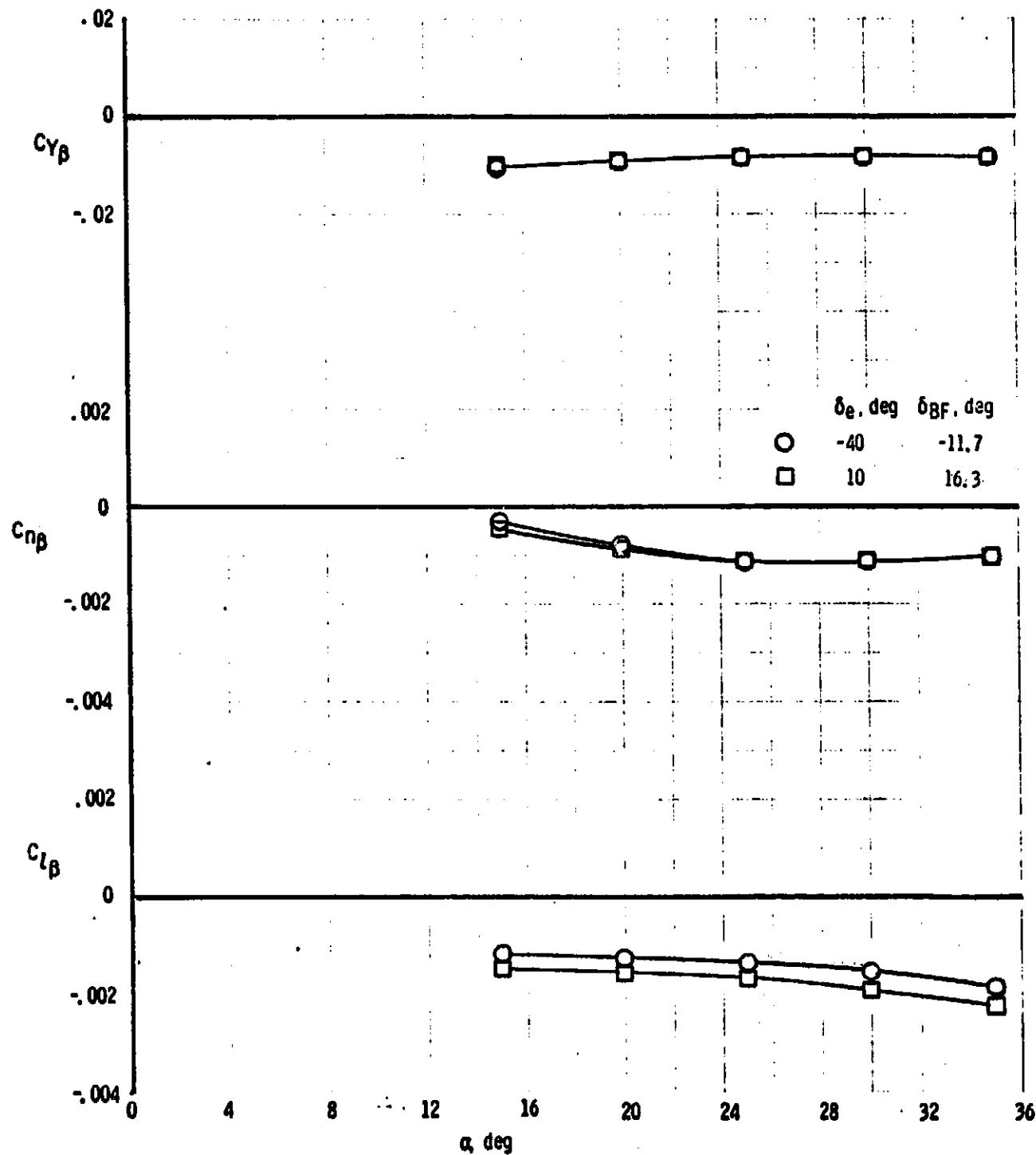
(e)   Configuration $B_1 WVS_0 C_3 EF$

Figure 5. - Continued.
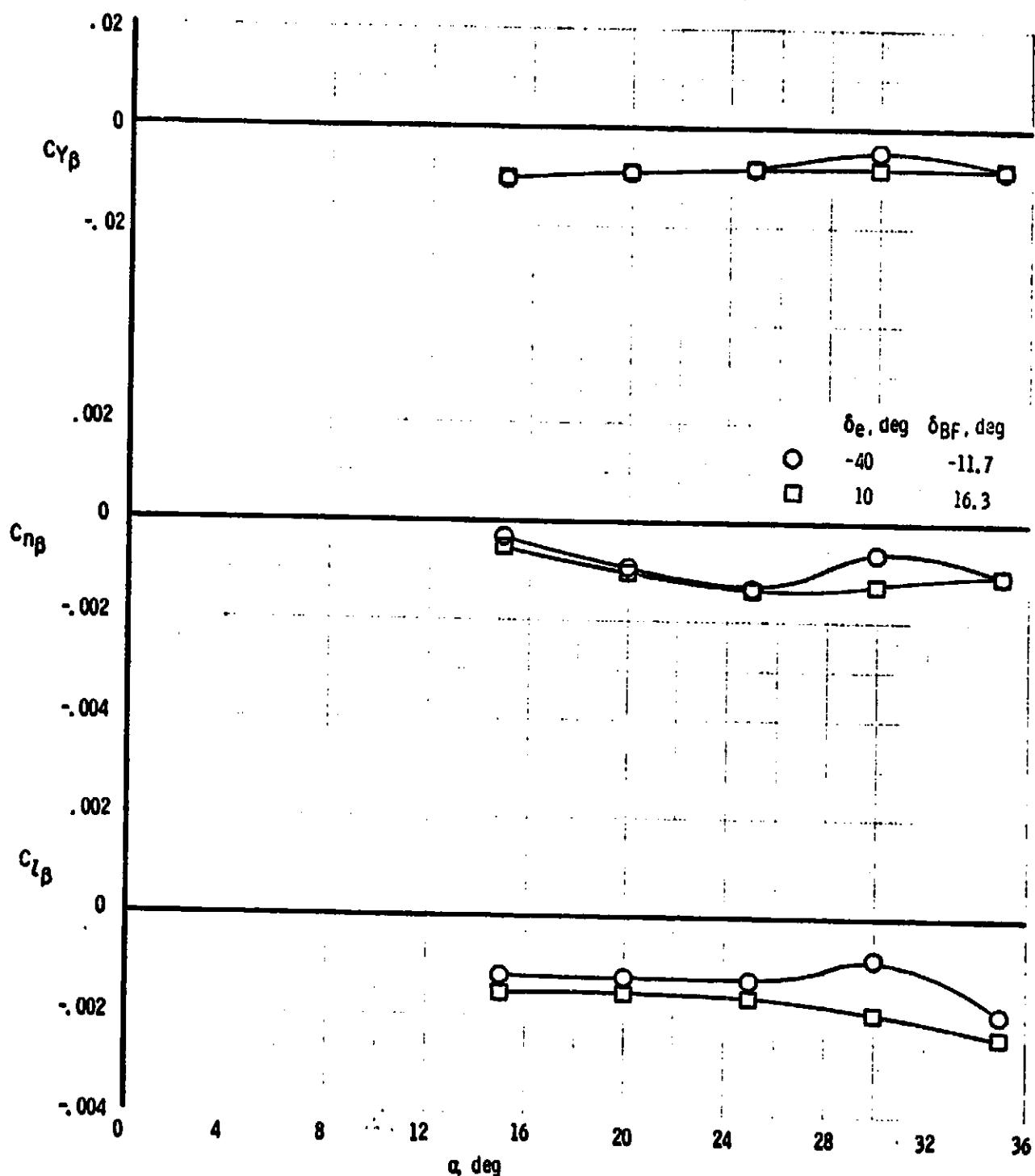
(f)   Configuration $B_2 WVS_0 C_3 EF$

Figure 5. - Continued.
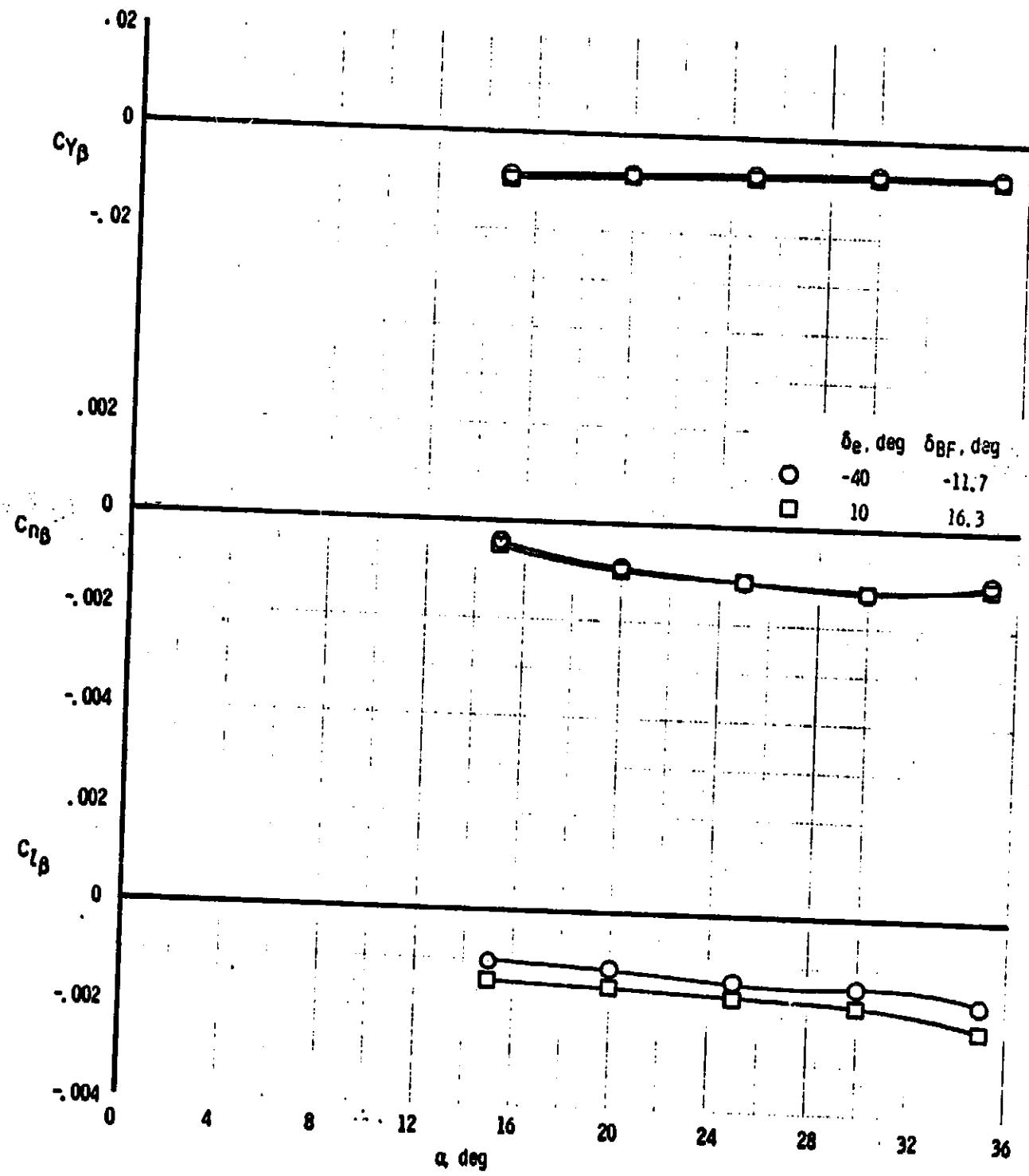
(g) Configuration $B_1 WVS_0 C_4 EF$

Figure 5. - Continued.
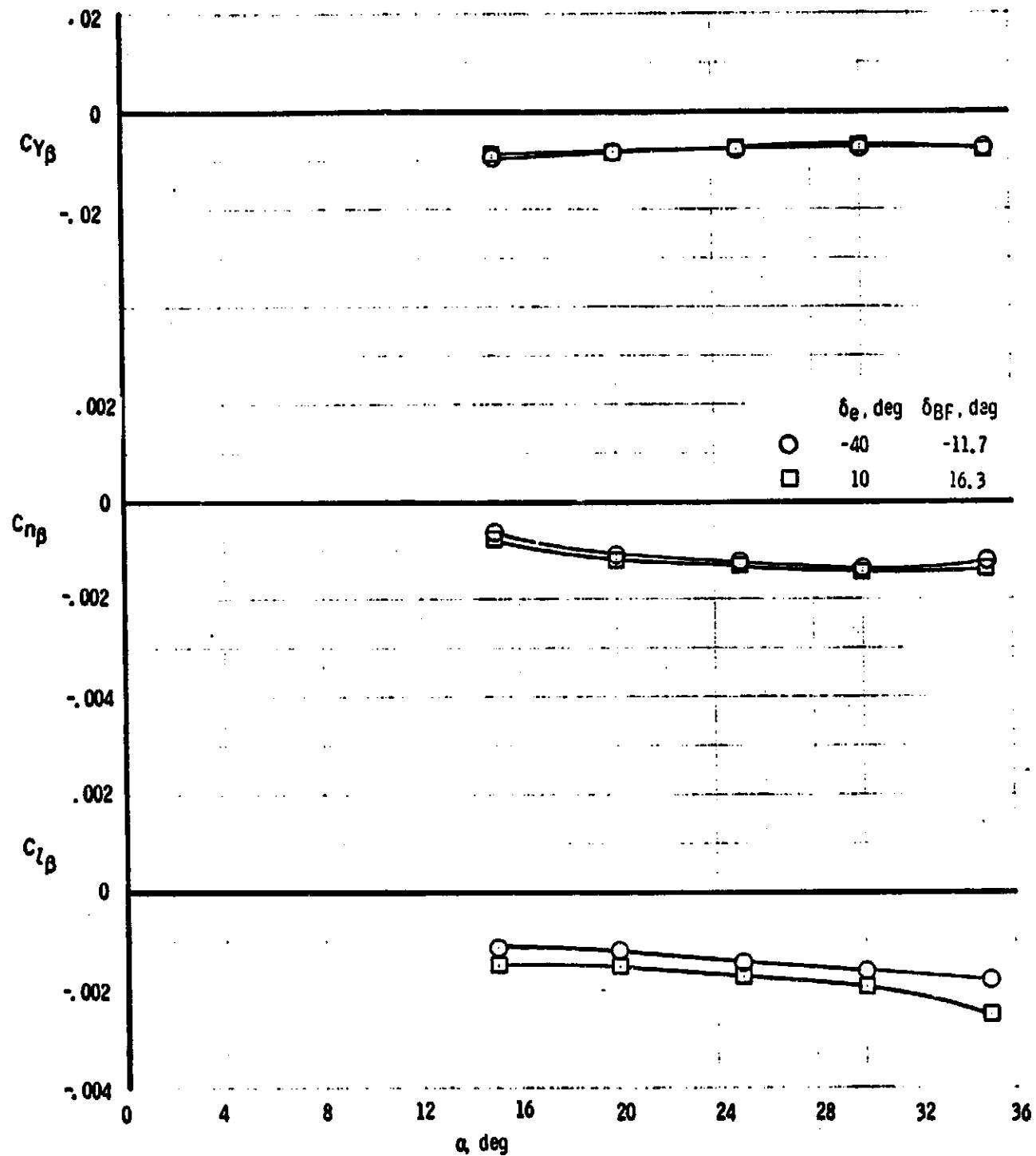
(h)   Configuration $B_1 WVS_0 C_5 EF$

Figure 5. - Concluded.

APPENDIX

Tabulated Data

The data presented herein are identified in table II (Data Set/Run Number Collation Summary) by configuration and run number. These data are also stored on tape in the Space Shuttle Data Management System (DATAMAN) and are identified by Shuttle test number LA-52 and data set identifier letter PH. Access to the data may be obtained by writing to the following address:

Chrysler Corporation, Space Division

Dept. 2910, P.O. Box 29200

New Orleans, LA 70189

TABLE II

TEST: LaRC-M6-6458 (LA52) DATA SET RUN NUMBER COLLATION SUMMARY DATE: 3 DECEMBER 1974

TEST RUN NUMBERS

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	δE	δBF	δSB	NO. OF RUNS	MACH NUMBERS 6.0
RHN001	B1 F1VWE1 S0	A	0	10	16.3	55	1	37
02			-5	10				38
03			0	0				39
04			-5					40
05			0	0	-11.7			41
06			-5					42
07			0	-20				43
08			-5	-20				44
09			0	-40				15
10			-5	-40				16
11	C3		0	10	16.3			35
12			-5	10	16.3			36
13			0	-40	-11.7			19
14	C4		-5	-40	-11.7			20
15			0	10	16.3			26
16			-5	10	16.3			27
17			0	-40	-11.7			9
18			-5	-40	-11.7			10

BETA, CN, CA, CLM, CBL, CYN, CY, CL, CD, L/D, MACH, ALPHA, L.0

COEFFICIENTS

α or β   A: 15° < α < 35°; Δα = 5°

SCHEDULES

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TEST: LaRC-M6-6458 (LA52) DATA SET RUN NUMBER COLLATION SUMMARY **DATE: 3 DECEMBER 1974**

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	β	δE	δBF	δSB	PARAMETERS/VALUES	NO. OF RUNS	MACH NUMBERS 6.0	TEST RUN NUMBER
RHM019	B1 F1VWE1 SO C41	A	0	10	16.3	55		1	5	
20			-5	10	16.3				6	
21			0	-40	-11.7				7	
22	S2		-5	-40	-11.7				8	
23			0	10	16.3				28	
24			-5	10	16.3				29	
25	SO		0	-40	-11.7				13	
26			-5	-40	-11.7				14	
27			0	10	16.3				48	
28			-5	10	16.3				49	
29			0	-40	-11.7				46	
30	C3		-5	-40	-11.7				47	
31			0	10	16.3				24	
32			-5	10	16.3				25	
33			0	-40	-11.7				21	
34			-5	-40	-11.7				22	

BETA   CN   CA   CLM   CBL   CYN   CY   CLL   CD   L/D   MACH   ALPHA   1.0

α or β   A: 15° < α < 35°; Δα = 5°

SCHEDULES

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TEST : LaRC-M6-6458 (LA52)　　**DATA SET RUN NUMBER COLLATION SUMMARY**　　**DATE : 3 DECEMBER 1974**

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	δE	δBF	δSB	PARAMETERS/VALUES	NO. OF RUNS	MACH NUMBERS 6.0
RHN035	B2 F1VWE1 S2	A	0	10	16.3	55		1	30
36			-5	10	16.3				31
37			0	-40	-1.7				11
38			-5	-40	-1.7				12

BETA, CN, CA, CLM, CBL, CYN, CY, CLL, CD, L/D, MACH, ALPHA, 1.0

A: 15° < α < 35°; Δα = 5°

α or β SCHEDULES　　COEFFICIENT

(4)

LA52 TABULATED SOURCE DATA

LARC W6-6458 (LA-52) ORBITER (B1F1W4E1SU)

PARAMETRIC DATA   (RUN201)

BETA = .000   ELEVTR = 10.000
AILRON = .000   BDFLAP = 16.399
SPDBRK = 55.000

RUN NO. 37/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.961	15.000	.00000	.32521	.07497	-.03591	.00045	.00048	-.00028	.29473	.15659	1.88215
5.963	20.000	.00000	.49543	.07820	-.04813	.00059	.00074	.00026	.43881	.24293	1.80633
5.964	25.000	.00000	.69560	.08541	-.06699	.00098	.00038	.00122	.59434	.37138	1.60035
5.965	30.000	.00000	.90985	.09119	-.08916	.00102	.00065	.00065	.74236	.53390	1.39044
5.967	35.000	.00000	1.14758	.09654	-.11592	.00090	.00104	.00125	.88467	.73730	1.19988

LARC W6-6458 (LA-52) ORBITER (B1F1W4E1SD)

PARAMETRIC DATA   (RUN202)

BETA = -5.000   ELEVTR = 10.000
AILRON = .000   BDFLAP = 16.399
SPDBRK = 55.000

RUN NO. 38/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.973	15.000	-5.00000	.32545	.07628	-.03666	.00841	.00206	.05236	.29462	.15791	1.86573
5.973	20.000	-5.00000	.49466	.07942	-.04987	.00882	.00539	.04827	.43766	.24361	1.79511
5.971	25.000	-5.00000	.69223	.08496	-.06803	.00939	.00698	.04518	.59185	.36873	1.60511
5.971	30.000	-5.00000	.91366	.09061	-.08930	.01099	.00759	.04577	.74612	.53549	1.39358
5.958	35.000	-5.00000	1.13598	.09518	-.11451	.01234	.00801	.04423	.87595	.72953	1.20070

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OF P...

LA52 TABULATED SOURCE DATA

LARC M6-6458 (LA-52) ORBITER (B1F1W4E1S0)

RUN NO. 39/ 0

PARAMETRIC DATA (RHNO03)

		BETA =	.000	ELEVTR =	.000
		AILRON =	.000	BDFLAP =	16.300
		SPDBRK =	55.000		

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.961	15.000	.00000	.29673	.06912	-.01544	.00014	.00060	-.00058	.26673	.14356	1.87185
5.963	20.000	.00000	.46534	.07130	-.02243	.00028	.00092	.00005	.41289	.22616	1.82568
5.964	25.000	.00000	.65384	.07465	-.03320	.00061	.00062	.00124	.56104	.34398	1.63102
5.966	30.000	.00000	.86445	.07709	-.04882	.00066	.00103	.00074	.71009	.49899	1.42306
5.965	35.000	.00000	1.08622	.07855	-.06850	.00080	.00133	.00117	.84473	.68738	1.22891

LARC M6-6458 (LA-52) ORBITER (B1F1W4E1S0)

RUN NO. 40/ 0

PARAMETRIC DATA (RHNO04)

		BETA =	-5.000	ELEVTR =	.000
		AILRON =	.000	BDFLAP =	16.300
		SPDBRK =	55.000		

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.974	15.000	-5.00000	.39104	.07087	-.01697	.00767	.00336	.05221	.27244	.14637	1.86137
5.972	20.000	-5.00000	.46213	.07161	-.02323	.00811	.00588	.04788	.40977	.22535	1.81635
5.972	25.000	-5.00000	.65362	.07426	-.03369	.00883	.00737	.04531	.56100	.34353	1.63394
5.971	30.000	-5.00000	.86164	.07664	-.04825	.01039	.00777	.04544	.70788	.49720	1.42375
5.961	35.000	-5.00000	1.07993	.07822	-.06728	.01199	.00859	.04468	.83976	.68349	1.22663

LA52 TABULATED SOURCE DATA

LARC M6-6458 (LA-52) ORBITER (B1F1WWE1SO)

RUN NO. 41/ 0

PARAMETRIC DATA (RHWD95)

BETA = .000 ELEVTR = .000
AILRON = .000 BDFLAP = -11.700
SPDBRK = 55.000

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/C
5.961	15.000	.00000	.28541	.06626	-.00100	.00022	.00071	-.00041	.25853	.13787	1.87513
5.963	20.000	.00000	.44505	.06575	.00149	.00029	.00102	.00024	.39572	.21490	1.84915
5.964	25.000	.00000	.62391	.06498	.00095	.00058	.00095	.00149	.53799	.32256	1.66787
5.964	30.000	.00000	.82569	.06551	-.00592	.00077	.00127	.00128	.67798	.46708	1.45134
5.964	35.000	.00000	1.03920	.06591	-.01760	.00101	.00147	.00169	.81346	.65705	1.25138

LARC M6-6458 (LA-52) ORBITER (B1F1WWE1SO)

RUN NO. 42/ 0

PARAMETRIC DATA (RHWD96)

BETA = -5.000 ELEVTR = .000
AILRON = .000 BDFLAP = -11.700
SPDBRK = 55.000

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/C
5.971	15.000	-5.00000	.28363	.06743	-.00043	.00072	.00331	.05279	.25651	.13854	1.85150
5.973	20.000	-5.00000	.44400	.06626	.00113	.00816	.02599	.04830	.39456	.21412	1.84272
5.973	25.000	-5.00000	.62514	.06649	-.00073	.00899	.03741	.04557	.53847	.32446	1.65960
5.976	30.000	-5.00000	.82736	.06670	-.00609	.01057	.00791	.04575	.68317	.47144	1.44909
5.975	35.000	-5.00000	1.04521	.06596	-.01737	.03214	.00863	.04502	.81635	.65353	1.25219

LA52 TABULATED SOURCE DATA

LARC MS-6458 (LA-52) ORBITER (B1F1W E15G)

PARAMETRIC DATA (RMOD07)

BETA =	.000	ELEVTR =	-20.000
AILRON =	.000	BDFLAP =	-11.700
SPDBRK =	55.000		

RUN NO. 43/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.961	15.000	.00000	.26731	.06798	.01388	-.00001	.00054	-.00095	.24960	.13485	1.78420
5.961	20.000	.00000	.41969	.06700	.02244	.00000	.00090	-.00036	.37146	.20650	1.79879
5.963	25.000	.00000	.58706	.06659	.02979	.00023	.00086	.00011	.50392	.30846	1.63365
5.964	30.000	.00000	.77228	.06605	.03283	.00022	.00117	.00085	.63579	.44334	1.43428
5.962	35.000	.00000	.96996	.06399	.03163	.00029	.00151	.00125	.73711	.60825	1.24474

LARC MS-6458 (LA-52) ORBITER (B1F1W E15G)

PARAMETRIC DATA (RMOD08)

BETA =	-5.000	ELEVTR =	-20.000
AILRON =	.000	BDFLAP =	-11.700
SPDBRK =	55.000		

RUN NO. 44/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.969	15.000	-5.00000	.26726	.06818	.01511	.00661	.00323	.05131	.24052	.13503	1.78122
5.969	20.000	-5.00000	.41199	.06670	.02232	.00681	.00580	.04744	.36433	.20359	1.78952
5.968	25.000	-5.00000	.58439	.06701	.02890	.00739	.00746	.04528	.50132	.30770	1.62923
5.968	30.000	-5.00000	.76907	.06653	.03265	.00874	.00792	.04505	.63276	.44215	1.43310
5.964	35.000	-5.00000	.96910	.06441	.03196	.01015	.00847	.04452	.75699	.60862	1.24364

LA52 TABULATED SOURCE DATA

LARC M6-6458 (LA-52) ORBITER (B1F1VWE1S0)

RUN NO   15/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.957	15.000	.00000	.25202	.07354	.02107	.00001	.00087	-.00061	.22440	.13627	1.64660
5.963	20.000	.00000	.40424	.07079	.02781	-.00001	.00090	.00026	.35565	.20470	1.73676
5.973	25.000	.00000	.57223	.07025	.03467	-.00006	.00107	.00118	.48893	.30559	1.60039
5.976	30.000	.00000	.74527	.06972	.03828	.00008	.00122	.00125	.62009	.43852	1.41406
5.960	35.000	.00000	.95673	.06853	.03954	-.00013	.00159	.00103	.74440	.60490	1.23062

LARC M6-6458 (LA-52) ORBITER (B1F1VWE1S0)

RUN NO. 16/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.976	15.000	-5.00000	.24913	.07459	.02909	.00652	.00321	.04924	.22131	.13662	1.61908
5.969	20.000	-5.00000	.40425	.07196	.02703	.00663	.00613	.04471	.35526	.22588	1.72256
5.958	25.000	-5.00000	.57203	.07129	.03407	.00706	.00792	.04150	.48831	.30636	1.59388
5.585	30.000	-5.00000	.76582	.07066	.03918	.00832	.00842	.04183	.62789	.44410	1.41304
6.012	35.000	-5.00000	.97060	.07020	.04085	.00941	.00913	.04099	.75480	.61422	1.22848

LA52 TABULATED SOURCE DATA

LARC MS-6458 (LA-52) ORBITER (B1F1VWE1S0C3)

RUN NO.   35/ 0

PARAMETRIC DATA (RMWD11)

BETA   =   .000   ELEVTR =   10.000
AILRON =   .000   BDFLAP =   16.300
SPDBRK =   55.000

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.956	15.000	.00000	.34999	.07932	-.01756	.00092	.00072	-.00030	.31745	.16718	1.89889
5.955	20.000	.00000	.52771	.08481	-.02104	.00081	.00053	.00034	.46088	.26018	1.79445
5.959	25.000	.00000	.74016	.09213	-.02855	.00089	.00067	.00038	.63188	.39630	1.59443
5.959	30.000	.00000	.96299	.09861	-.04563	.00096	.00100	.00060	.78467	.56689	1.38416
5.960	34.000	.00000	1.19739	.10487	-.05559	.00106	.00094	.00139	.93404	.75651	1.23467

LARC MS-6458 (LA-52) ORBITER (B1F1VWE1S0C3)

RUN NO.   36/ 0

PARAMETRIC DATA (RMWD12)

BETA   =   -5.000   ELEVTR =   10.000
AILRON =   .000   BDFLAP =   16.300
SPDBRK =   55.000

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.970	15.000	-5.00000	.33982	.08063	-.01731	.01793	.00312	.04966	.30738	.16584	1.85349
5.969	20.000	-5.00000	.52367	.08591	-.02204	.00870	.00497	.04556	.46270	.25983	1.78077
5.967	25.000	-5.00000	.72864	.09206	-.02964	.00933	.00636	.04197	.62146	.39137	1.58791
5.968	30.000	-5.00000	.96233	.09942	-.04201	.01061	.00664	.04117	.78369	.56726	1.38154
5.917	35.000	-5.00000	1.15747	.10178	-.05547	.01224	.00594	.04043	.88976	.74727	1.19568

LA52 TABULATED SOURCE DATA

LARC MS-6456 (LA-52) ORBITER (B1F1W1E1S0C3)

RUN NO. 19/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.980	15.000	.00000	.27355	.07798	.03833	.00002	.00103	-.00047	.24405	.14612	1.67020
5.983	20.000	.00000	.43186	.07773	.05450	.00016	.00079	.00063	.37923	.22074	1.71798
5.981	25.000	.00000	.61??	.07905	.07192	.00010	.00098	.00081	.52422	.33167	1.58057
5.951	30.000	.00000	.807??	.07917	.08658	.00010	.00127	.00121	.65997	.47245	1.39690
5.953	35.000	.00000	1.02645	.07977	.09888	.00016	.00140	.00156	.79507	.65499	1.21553

LARC MS-6456 (LA-52) ORBITER (B1F1W1E1S0C3)

RUN NO. 20/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.975	15.000	-5.00000	.26929	.07676	.03771	.00588	.00267	.05214	.23973	.14577	1.64455
5.975	20.000	-5.00000	.42841	.07838	.05410	.00648	.00484	.04711	.37577	.22018	1.70666
5.975	25.000	-5.00000	.61298	.07967	.07120	.00689	.00677	.04285	.52188	.33127	1.57540
5.975	30.000	-5.00000	.80274	.08090	.08546	.00783	.00696	.04305	.65475	.47143	1.38885
5.975	35.000	-5.00000	1.02648	.08058	.09673	.00951	.00665	.04330	.79462	.65477	1.21359

LA52 TABULATED SOURCE DATA

LARC M6-6458 (LA-52) ORBITER (B1F1VWE1S0C4)

RUN NO. 26/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN
5.965	15.000	.00000	.35858	.07867	-.00990	.00055	.00073
5.965	20.000	.00000	.54358	.08497	-.01036	.00076	.00073
5.965	25.000	.00000	.75548	.09262	-.01360	.00091	.00078
5.965	30.000	.00000	.98358	.09891	-.02193	.00119	.00079
5.966	35.000	.00000	1.22812	.10529	-.03226	.00115	.00078

(RHMD15)

PARAMETRIC DATA

BETA = .000   ELEVTR = 10.000
AILRON = .000   BDFLAP = 16.399
SPDBRK = 55.000

CL	CY	CD	L/C
.32600	.00002	.16879	1.93137
.48173	.00069	.26576	1.81266
.64555	.00069	.40322	1.60097
.80235	.00122	.57745	1.38947
.94562	.00160	.79067	1.19598

LARC M6-6458 (LA-52) ORBITER (B1F1VWE1S0C4)

RUN NO. 27/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN
5.973	15.000	-5.00000	.34666	.08015	-.00983	.00775	.00336
5.972	20.000	-5.00000	.54166	.08606	-.01090	.00837	.00560
5.972	25.000	-5.00000	.74592	.09294	-.01481	.00931	.00642
5.972	30.000	-5.00000	.97999	.09991	-.02308	.01018	.00726
6.000	35.000	-5.00000	1.25303	.10886	-.03492	.01239	.00666

(RHMD16)

PARAMETRIC DATA

BETA = -5.000   ELEVTR = 10.000
AILRON = .000   BDFLAP = 16.399
SPDBRK = 55.000

CL	CY	CD	L/C
.31411	.04853	.16714	1.87933
.47956	.04345	.26613	1.80198
.63675	.04175	.39947	1.59399
.79874	.03982	.57652	1.38546
.96398	.04109	.80788	1.19322

LA52 TABULATED SOURCE DATA

LARC M6-6456 (LA-52) ORBITER (B1F1VWE1S0C4)

RUN NO. 9/ 0

PARAMETRIC DATA

BETA =	.000	ELEVTR = -40.000
AILRON =	.000	BDFLAP = -11.700
SPDBRK =	55.000	(RHND17)

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CL	CY	CD	L/C
5.971	15.000	.00000	.28982	.07829	.04538	.00049	.00131	.28968	-.00106	.15963	1.72398
5.960	20.000	.00000	.45763	.07890	.06541	.00049	.00118	.40305	-.00005	.23966	1.74738
5.961	25.000	.00000	.63648	.08122	.08674	.00045	.00127	.54252	.00071	.34259	1.58357
5.983	30.000	.00000	.84237	.08170	.10514	.00044	.00149	.68866	.00108	.49194	1.39948
5.991	35.000	.00000	1.04712	.08185	.12105	.00043	.00182	.81060	.00128	.66765	1.21441

LARC M6-6456 (LA-52) ORBITER (B1F1VWE1S0C4)

RUN NO. 10/ 0

PARAMETRIC DATA

BETA =	-5.000	ELEVTR = -40.000
AILRON =	.000	BDFLAP = -11.700
SPDBRK =	55.000	(RHND18)

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CL	CY	CD	L/C
6.001	15.000	-5.00000	.28027	.07663	.04451	.00576	.00037	.25037	.04506	.14849	1.68604
5.994	20.000	-5.00000	.44292	.07636	.06369	.00623	.00574	.38941	.04062	.22513	1.72974
5.977	25.000	-5.00000	.63180	.08053	.08528	.00714	.00699	.53857	.03846	.34000	1.58405
5.969	30.000	-5.00000	.83736	.08225	.10396	.00748	.00609	.68405	.03657	.48991	1.39626
5.962	35.000	-5.00000	1.04908	.08312	.11949	.00900	.00726	.81168	.03749	.66982	1.21179

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LA52 TABULATED SOURCE DATA

LARC M5-6450 (LA-52) ORBITER (B1F1VWE19OC41)

PARAMETRIC DATA (RHN019)

BETA =	.000
AILRON =	.000
SPDBRK =	55.000

ELEVTR =	10.000
BDFLAP =	16.300

RUN NO. 5/0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN
5.983	15.000	.00000	.35469	.08041	-.01376	.00063	.00063
5.969	20.000	.00000	.53948	.08732	-.01660	.00137	.00042
5.972	25.000	.00000	.74981	.09557	-.02330	.00167	.00043
5.990	30.000	.00000	.97444	.10221	-.03525	.00198	.00029
5.991	35.000	.00000	1.21359	.10866	-.04930	.00230	.00006

CY	CL	CD	L/D
-.00160	.32179	.16948	1.89675
-.00122	.47708	.26656	1.78976
-.00121	.63917	.40350	1.58408
-.00164	.79279	.57574	1.37699
-.00094	.93179	.78510	1.18605

LARC M5-6450 (LA-52) ORBITER (B1F1VWE19OC41)

PARAMETRIC DATA (RHN020)

BETA =	-5.000
AILRON =	.000
SPDBRK =	55.000

ELEVTR =	10.000
BDFLAP =	16.300

RUN NO. 6/0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN
6.007	15.000	-5.00000	.34571	.08145	-.01324	.00627	.00457
6.004	20.000	-5.00000	.53021	.08799	-.01649	.00860	.00637
6.003	25.000	-5.00000	.73867	.09560	-.02272	.01026	.00687
6.005	30.000	-5.00000	.97174	.10283	-.03431	.01161	.00749
6.069	35.000	-5.00000	1.26929	.11462	-.05057	.01481	.00705

CY	CL	CD	L/D
.04320	.31285	.16815	1.86052
.03929	.46814	.26403	1.77398
.03757	.62996	.39882	1.57732
.03595	.79514	.57492	1.37434
.03808	.97400	.82192	1.18502

LA52 TABULATED SOURCE DATA

LARC M5-6458 (LA-52) ORBITER (B1F1W4E1S0C41)

RUN NO. 7/ 0

PARAMETRIC DATA

BETA = .000 ELEVTR = -40.000
AILRON = .000 BDFLAP = -11.700
SPDBRK = 55.000

(RHN021)

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CL	CD	L/D	CY
5.968	15.000	.00000	.28049	.07938	.04164	.00074	.00151	.25908	.15160	1.70992	-.00134
5.961	20.000	.00000	.44842	.08100	.05963	.00161	.00139	.39367	.22948	1.71549	-.00071
5.957	25.000	.00000	.63334	.08324	.07722	.00109	.00137	.53882	.34311	1.57042	-.00043
5.965	30.000	.00000	.82847	.08459	.09156	.00130	.00137	.67518	.48749	1.38592	-.00070
5.978	35.000	.00000	1.03253	.08443	.10401	.00157	.00113	.79737	.66140	1.20558	.00034

LARC M5-6458 (LA-52) ORBITER (B1F1W4E1S0C41)

RUN NO. 8/ 0

PARAMETRIC DATA

BETA = -5.000 ELEVTR = -40.000
AILRON = .000 BDFLAP = -11.700
SPDBRK = 55.000

(RHN022)

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CL	CD	L/D	CY
5.995	15.000	-5.00000	.28471	.07977	.04090	.00636	.00462	.25436	.15074	1.68743	.04528
5.993	20.000	-5.00000	.44268	.08091	.05861	.00696	.00689	.38850	.22750	1.70769	.04086
5.993	25.000	-5.00000	.62112	.08258	.07631	.00826	.00748	.52892	.33734	1.56527	.03659
5.991	30.000	-5.00000	.82342	.08401	.09105	.00931	.00822	.67110	.48447	1.38522	.03687
5.909	35.000	-5.00000	.97374	.08000	.09725	.01054	.00721	.75176	.62405	1.20464	.03594

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LA52 TABULATED SOURCE DATA

LARC M6-6456 (LA-52) ORBITER (B1F1W4E1S2)

RUN NO. 28/ 0

PARAMETRIC DATA (RM4023)

BETA   = .000   ELEVTR = 10.000
AILRON = .000   BDFLAP = 16.300
SPDBRK = 55.000

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.964	15.000	.00000	.34036	.07691	-.01594	.00057	.00100	.00017	.30886	.16238	1.90204
5.966	20.000	.00000	.52599	.08205	-.01867	.00104	.00090	.00110	.46621	.25700	1.81401
5.966	25.000	.00000	.73752	.08819	-.02741	.00123	.00114	.00158	.63115	.39162	1.61166
5.965	30.000	.00000	.95914	.09402	-.03772	.00131	.00146	.00177	.78363	.56100	1.39685
5.967	35.000	.00000	1.19987	.10761	-.05136	.00144	.00192	.00281	.92517	.77063	1.20054

LARC M6-6456 (LA-52) ORBITER (B1F1W4E1S2)

RUN NO. 29/ 0

PARAMETRIC DATA (RM4024)

BETA   = -5.000   ELEVTR = 10.000
AILRON = .000   BDFLAP = 16.300
SPDBRK = 55.000

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.974	15.000	-5.00000	.33361	.07763	-.01701	.00882	.00184	.05970	.30210	.16152	1.87036
5.973	20.000	-5.00000	.52243	.08279	-.02089	.00877	.00491	.04314	.46260	.25648	1.80369
5.971	25.000	-5.00000	.72589	.08699	-.02683	.00966	.00661	.03851	.62027	.38742	1.60101
5.981	30.000	-5.00000	.95640	.09629	-.03645	.01173	.00653	.03936	.78012	.56159	1.38912
5.979	35.000	-5.00000	1.20414	.10242	-.05089	.01308	.00737	.03712	.92763	.77456	1.19762

LA52 TABULATED SOURCE DATA

LARC M6-6458 (LA-52) ORBITER (B1F1WME1S2)

RUN NO. 13/ 0

PARAMETRIC DATA (RHWD25)

BETA = .000	ELEVTR = -40.000
AILRON = .000	BDFLAP = -11.700
SPDBRK = 55.000	

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.974	15.000	.00000	.27103	.07709	.04033	.00008	.00151	.00038	.24184	.14461	1.67238
5.970	20.000	.00000	.43256	.07648	.05794	.00022	.00143	.00177	.38031	.21981	1.73019
5.982	25.000	.00000	.61145	.07624	.07368	.00052	.00154	.00258	.52194	.32751	1.59368
5.999	30.000	.00000	.81245	.07634	.08936	.00044	.00212	.00277	.66543	.47233	1.40842
5.968	35.000	.00000	1.02505	.07707	.10170	.00051	.00255	.00329	.79547	.65107	1.22178

LARC M6-6458 (LA-52) ORBITER (B1F1WME1S2)

RUN NO. 14/ 0

PARAMETRIC DATA (RHWD26)

BETA = -5.000	ELEVTR = -40.000
AILRON = .000	BDFLAP = -11.700
SPDBRK = 55.000	

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.997	15.000	-5.00000	.26620	.07762	.03866	.00660	.00225	.04692	.23704	.14307	1.64735
5.979	20.000	-5.00000	.42713	.07686	.05596	.00643	.00545	.04056	.37508	.21831	1.71813
5.975	25.000	-5.00000	.60957	.07721	.07214	.00729	.00725	.03674	.51983	.32759	1.58682
5.975	30.000	-5.00000	.80565	.07783	.08742	.00899	.00746	.03620	.65879	.47023	1.40102
5.975	35.000	-5.00000	1.02414	.07732	.10130	.00986	.00856	.03461	.79457	.65076	1.22109

LA52 TABULATED SOURCE DATA

LARC M6-6458 (LA-52) ORBITER (B2F1VWE15O)

PARAMETRIC DATA

BETA = .000	ELEVTR = 10.000
AILRON = .000	BDFLAP = 16.300
SPDBRK = 55.000	

(RUN027)

RUN NO. 48/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CL	CY	CO	L/D
5.961	15.000	.00000	.33072	.07895	-.02620	.00068	-.00044	.29902	-.00171	.16166	1.84742
5.961	20.000	.00000	.50391	.08423	-.04116	.00100	-.00063	.44472	-.00136	.25149	1.76830
5.962	25.000	.00000	.69779	.09011	-.05928	.00119	-.00070	.59433	-.00182	.37657	1.57827
5.962	30.000	.00000	.91820	.09658	-.08290	.00114	-.00047	.74690	-.00197	.54274	1.37616
5.962	35.000	.00000	1.14496	.10217	-.11016	.00137	-.00064	.87929	-.00065	.74041	1.18757

LARC M6-6458 (LA-52) ORBITER (B2F1VWE15O)

PARAMETRIC DATA

BETA = -5.000	ELEVTR = 10.000
AILRON = .000	BDFLAP = 16.300
SPDBRK = 55.000	

(RUN028)

RUN NO. 49/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CL	CY	CO	L/D
5.968	15.000	-5.00000	.32493	.07844	-.02501	.00063	.00219	.29355	.05051	.15966	1.83628
5.965	20.000	-5.00000	.49971	.08391	-.04144	.00074	.00554	.44119	.04517	.24892	1.77243
5.965	25.000	-5.00000	.69309	.08926	-.05941	.00094	.00676	.59044	.04211	.37381	1.57951
5.965	30.000	-5.00000	.91182	.09644	-.08239	.01125	.00629	.74144	.04294	.53943	1.37447
5.965	35.000	-5.00000	1.14559	.10327	-.10931	.01294	.00596	.87918	.04224	.74168	1.18539

LA52 TABULATED SOURCE DATA

LARC MB-6456 (LA-52) ORBITER (B2F1W4E15O)

PARAMETRIC DATA

BETA = .000   ELEVTR = -40.000
AILRON = .000   BDFLAP = -11.700
SPDBRK = 55.000

RUN NO. 46/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.983	15.000	.00000	.25483	.07732	.03349	.00006	.00030	-.00151	.22613	.14064	1.60790
5.990	20.000	.00000	.40493	.07604	.03727	.00012	.00019	-.00133	.35365	.20964	1.68697
5.983	25.000	.00000	.57683	.07603	.04278	.00008	.00028	-.00139	.49064	.31270	1.56904
5.983	30.000	.00000	.76125	.07561	.04698	-.00003	.00045	-.00151	.62146	.44610	1.39309
5.983	35.000	.00000	.95425	.07591	.04769	.00022	.00032	-.00067	.73665	.60877	1.21334

LARC MB-6456 (LA-52) ORBITER (B2F1W4E15O)

PARAMETRIC DATA

BETA = -5.000   ELEVTR = -40.000
AILRON = .000   BDFLAP = -11.700
SPDBRK = 55.000

RUN NO. 47/ D

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.988	15.000	-5.00000	.23226	.07684	.03236	.00064	.00220	.03183	.22393	.13093	1.81178
5.988	20.000	-5.00000	.40476	.07512	.03584	.00648	.00561	.04644	.35466	.20902	1.69674
5.988	25.000	-5.00000	.57427	.07555	.04265	.00673	.00770	.04236	.48854	.31117	1.57032
5.970	30.000	-5.00000	.75442	.07654	.04720	.00031	.00740	.04361	.61508	.44349	1.38609
5.974	35.000	-5.00000	.95957	.07647	.04895	.00988	.00666	.04341	.74217	.61393	1.21066

LA52 TABULATED SOURCE DATA

LARC MS-6458 (LA-52) ORBITER (B2F1W6E1S0C3)

RUN NO. 24/ 0

PARAMETRIC DATA

BETA   =   .000   ELEVTR = 10.000
AILRON =   .000   BDFLAP = 16.300
SPDBRK = 55.000   (RN#031)

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.956	15.000	.00000	.34974	.08078	-.00903	.00061	-.00031	-.00114	.31692	.16855	1.88025
5.957	20.000	.00000	.53026	.08715	-.01448	.00095	-.00052	-.00110	.46847	.26326	1.77953
5.958	25.000	.00000	.73686	.09442	-.02272	.00313	-.00056	-.00149	.62792	.39698	1.58173
5.959	30.000	.00000	.96441	.10175	-.03536	.00108	-.00041	-.00203	.78433	.57032	1.37524
5.959	35.000	.00000	1.20593	.10896	-.05187	.00130	-.00069	-.00095	.92534	.78095	1.18490

LARC MS-6458 (LA-52) ORBITER (B2F1W6E1S0C3)

RUN NO. 25/ 0

PARAMETRIC DATA

BETA   = -5.000   ELEVTR = 10.000
AILRON =   .000   BDFLAP = 16.300
SPDBRK = 55.000   (RN#032)

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.968	15.000	-5.00000	.34126	.08151	-.00720	.00039	.00241	.04939	.39854	.16736	1.84687
5.969	20.000	-5.00000	.52284	.08741	-.01478	.00073	.00469	.04369	.46141	.26096	1.76811
5.966	25.000	-5.00000	.72677	.09452	-.02387	.00929	.00635	.03904	.61073	.39281	1.57515
5.968	30.000	-5.00000	.95713	.10271	-.03649	.01077	.00602	.03876	.77754	.56751	1.37009
5.967	35.000	-5.00000	1.20566	.11029	-.05364	.01326	.00475	.03953	.92436	.78188	1.18222

LA52 TABULATED SOURCE DATA

LARC MS-6458 (LA-52) ORBITER (B2F1WE1SDC3)

RUN NO. 21/ 0

(RUN=23)

PARAMETRIC DATA

BETA =	.000	ELEVTR =	-40.000
AILRON =	.000	BDFLAP =	-11.700
SPDBRK =	55.000		

CL	CD	L/D
.24518	.14917	1.64360
.38363	.22575	1.69940
.52444	.33638	1.55930
.66171	.47918	1.38092
.79940	.65694	1.20517

CY	CBL	CYN
-.00221	.00006	.00024
-.00138	.00022	-.00012
-.00169	.00022	-.00007
-.00228	.00020	.00019
-.00144	.00026	-.00009

MACH	ALPHA	BETA	CN	CA	CLM
5.981	15.000	.00000	.27544	.08063	.04864
5.978	20.000	.00000	.43771	.08092	.06074
5.976	25.000	.00000	.61746	.08322	.07632
5.975	30.000	.00000	.81264	.08413	.09075
5.975	35.000	.00000	1.02426	.08477	.10264

LARC MS-6458 (LA-52) ORBITER (B2F1WE1SDC3)

RUN NO. 22/ 0

(RUN=24)

PARAMETRIC DATA

BETA =	-5.000	ELEVTR =	-40.000
AILRON =	.000	BDFLAP =	-11.700
SPDBRK =	55.000		

CL	CD	L/D
.24195	.14775	1.63763
.37942	.22437	1.69102
.52312	.33505	1.55760
.35221	.25596	1.37659
.80013	.66670	1.20014

CY	CBL	CYN
.05049	.00606	.00191
.04446	.00637	.03459
.03889	.00664	.00670
.02077	.00419	.00341
.04040	.00996	.00531

MACH	ALPHA	BETA	CN	CA	CLM
5.979	15.000	-5.00000	.27195	.08009	.04672
5.978	20.000	-5.00000	.43328	.08107	.06017
5.976	25.000	-5.00000	.61605	.08330	.07573
4.936	30.000	-5.00000	.43295	.04547	.04776
5.998	35.000	-5.00000	1.03783	.08719	.10170

LA52 TABULATED SOURCE DATA

LARC MS-6458 (LA-52) ORBITER (B2F1W4E1S2)

RUN NO. 30/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	.	L/D
5.967	15.000	.00000	.34163	.07861	-.09218	.00053	.00033	-.00044	.30964	.16433	1.84407
5.968	20.000	.00000	.52123	.08548	-.09779	.00092	.00039	.00020	.46057	.25059	1.78194
5.968	25.000	.00000	.73367	.09139	-.01706	.00133	.00027	.00056	.62631	.39289	1.59413
5.968	30.000	.00000	.96121	.09970	-.03031	.00126	.00057	.00007	.78259	.56695	1.38036
5.969	35.000	.00000	1.20572	.10703	-.04695	.00137	.00067	.00106	.92628	.77924	1.18869

LARC MS-6458 (LA-52) ORBITER (B2F1W4E1S2)

RUN NO. 31/ 0

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	.	L/D
5.974	15.000	-5.00000	.33495	.07985	-.09375	.00911	.00133	.04978	.35287	.16382	1.84374
5.973	20.000	-5.00000	.52216	.08574	-.01041	.00880	.00436	.04219	.46134	.25916	1.78703
5.973	25.000	-5.00000	.73451	.09348	-.01992	.00963	.00607	.03729	.62618	.39514	1.58471
5.958	30.000	-5.00000	.95412	.09950	-.02975	.01163	.00346	.03723	.77654	.55323	1.37874
5.958	35.000	-5.00000	1.19175	.10685	-.04450	.01354	.00585	.03552	.91493	.77109	1.18635

LA52 TABULATED SOURCE DATA

LARC MS-6458 (LA-52) ORBITER (B2F1WE1S2)

RUN NO. 11/ 0

PARAMETRIC DATA (RWN037)

BETA = .000 ELEVTR = -40.000
AILRON = .000 BDFLAP = -11.700
SPDBRK = 55.000

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.969	15.000	.00000	.27361	.07844	.05334	.00004	.00088	-.00064	.24399	.14658	1.66451
5.976	20.000	.00000	.43586	.07948	.06782	.00021	.00083	.00022	.38239	.22376	1.70894
5.978	25.000	.00000	.61125	.08055	.08088	.00040	.00085	.00086	.51994	.33133	1.56925
5.979	30.000	.00000	.81069	.08155	.09439	.00033	.00134	.00055	.66131	.47597	1.38949
5.982	35.000	.00000	1.01583	.08315	.10669	.00049	.00150	.00144	.78442	.65077	1.20537

LARC MS-6458 (LA-52) ORBITER (B2F1WE1S2)

RUN NO. 12/ 0

PARAMETRIC DATA (RWN038)

BETA = -5.000 ELEVTR = -40.000
AILRON = .000 BDFLAP = -11.700
SPDBRK = 55.000

MACH	ALPHA	BETA	CN	CA	CLM	CBL	CYN	CY	CL	CD	L/D
5.988	15.000	-5.00000	.27961	.07840	.05109	.00665	.00178	.04558	.24110	.14577	1.65396
5.988	20.000	-5.00000	.42628	.07886	.06414	.00651	.00488	.03914	.37360	.21990	1.69896
5.984	25.000	-5.00000	.61187	.08094	.07960	.00718	.00670	.03447	.52034	.33195	1.56752
5.988	30.000	-5.00000	.81601	.08298	.09504	.00913	.00665	.03439	.66565	.47959	1.38941
5.988	35.000	-5.00000	1.01655	.08275	.10707	.01020	.00710	.03280	.78525	.65086	1.20649